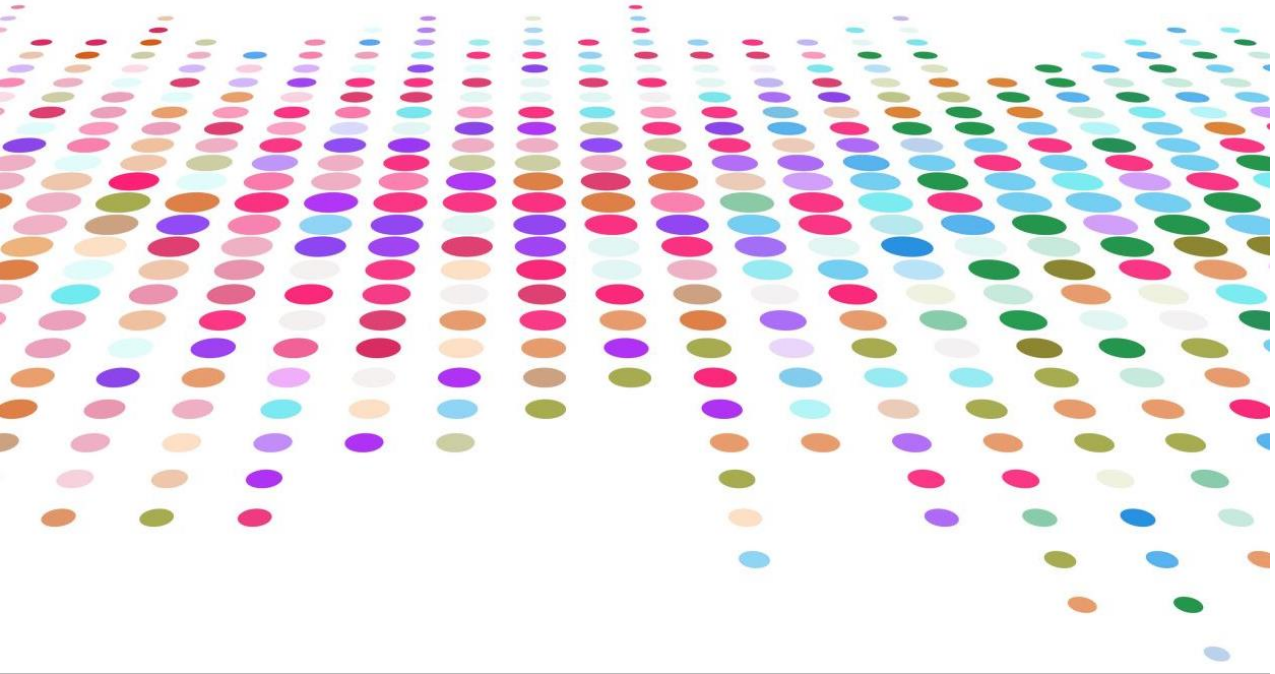
IN-BORE SGRT WITH HALCYON ELITE

INITIAL CLINICAL EXPERIENCE FROM A TERTIARY CANCER CENTER

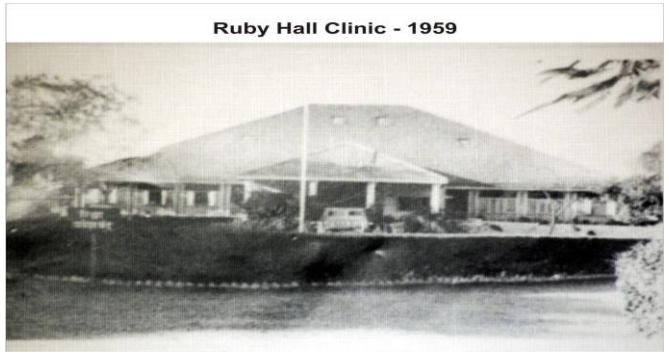


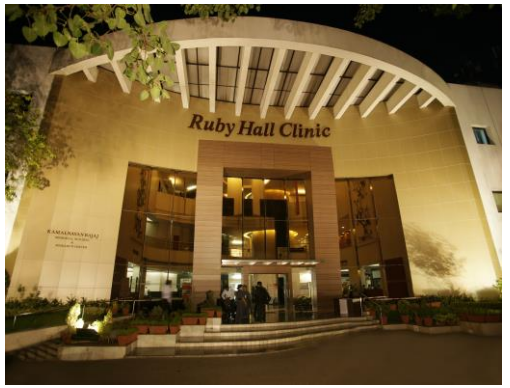
Dr Mansi Munshi Girme

Senior Radiation Oncologist

Ruby Hall Clinic, Pune

RUBY HALL CLINIC , PUNE





- 800 bedded multispecialty hospital

- Dedicated Cancer Center

- Every month

Surgery- 90-100

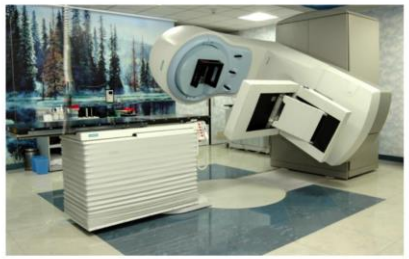
Chemo- 500-600

Radiation – 150-200

PET CT - 1200

HISTORY OF RADIATION DEPARTMENT

ONCOR Impression Plus



1976 — Telecobalt – Theratron Jr
- First radiotherapy facility in Pune

early 90's — In early 90's –> Phoenix telecobalt

2005 — First MVCBCT - IGRT First in Asia (other than Japan) - Oncor Impression Plus

2005 — Microselectron HDR Brachy

2011 — First FFF beam SRS/SRT on Oncor ST

2017 — Microselectron V3 HDR

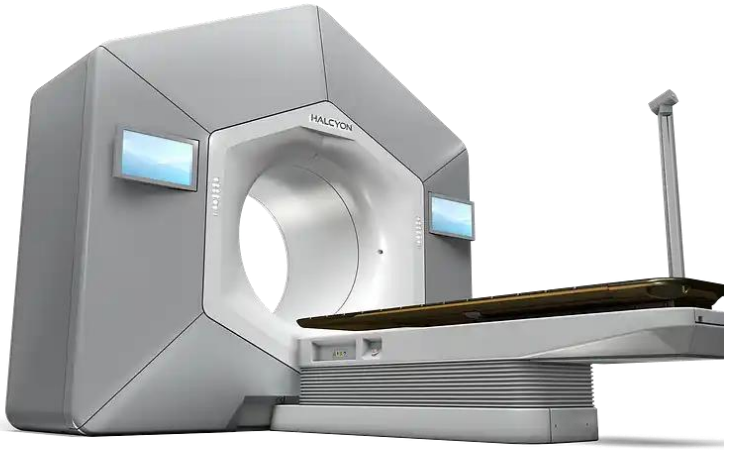
2019 — Truebeam STx with RPM / Cones

2020 — Halcyon Elite

2023 — Cyberknife S7

2024 — Align RT by Vision RT

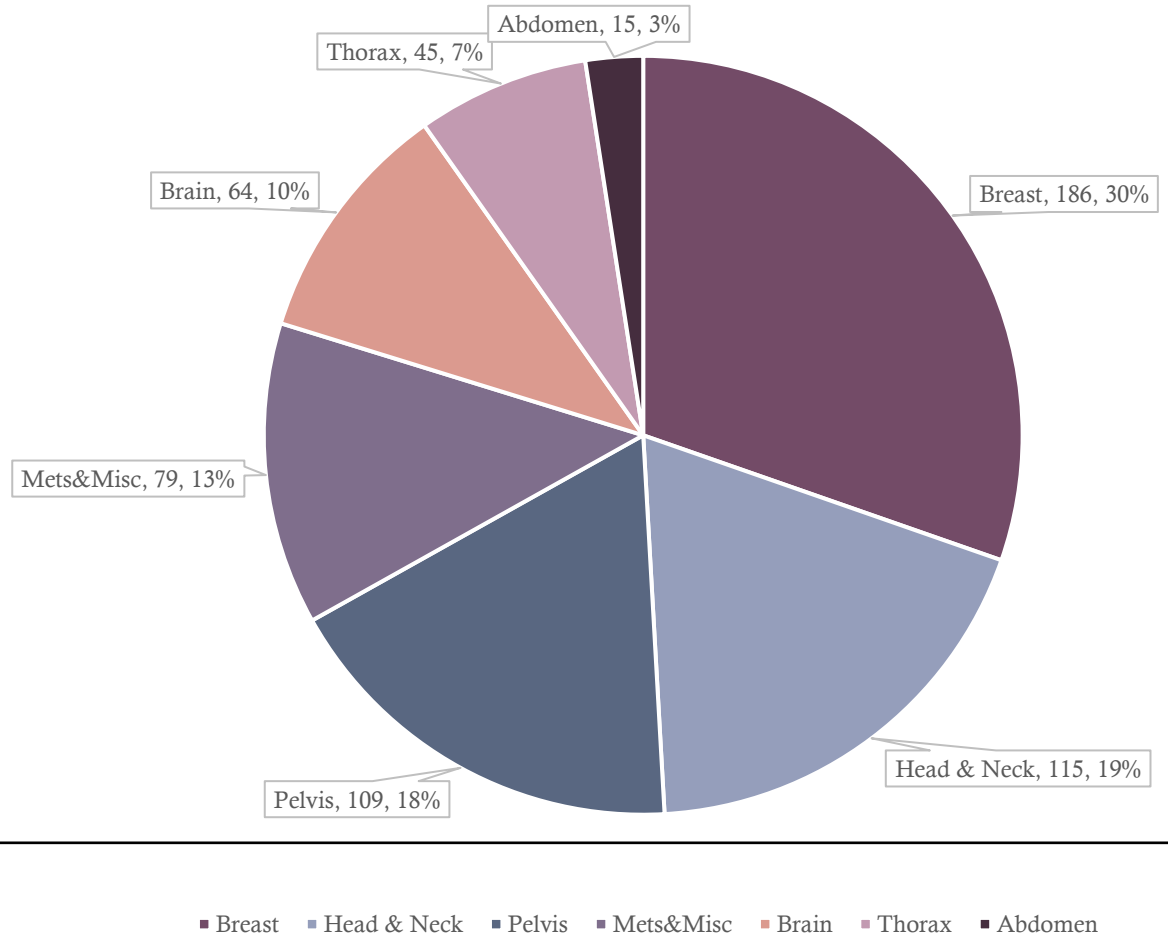
CURRENT EQUIPMENT

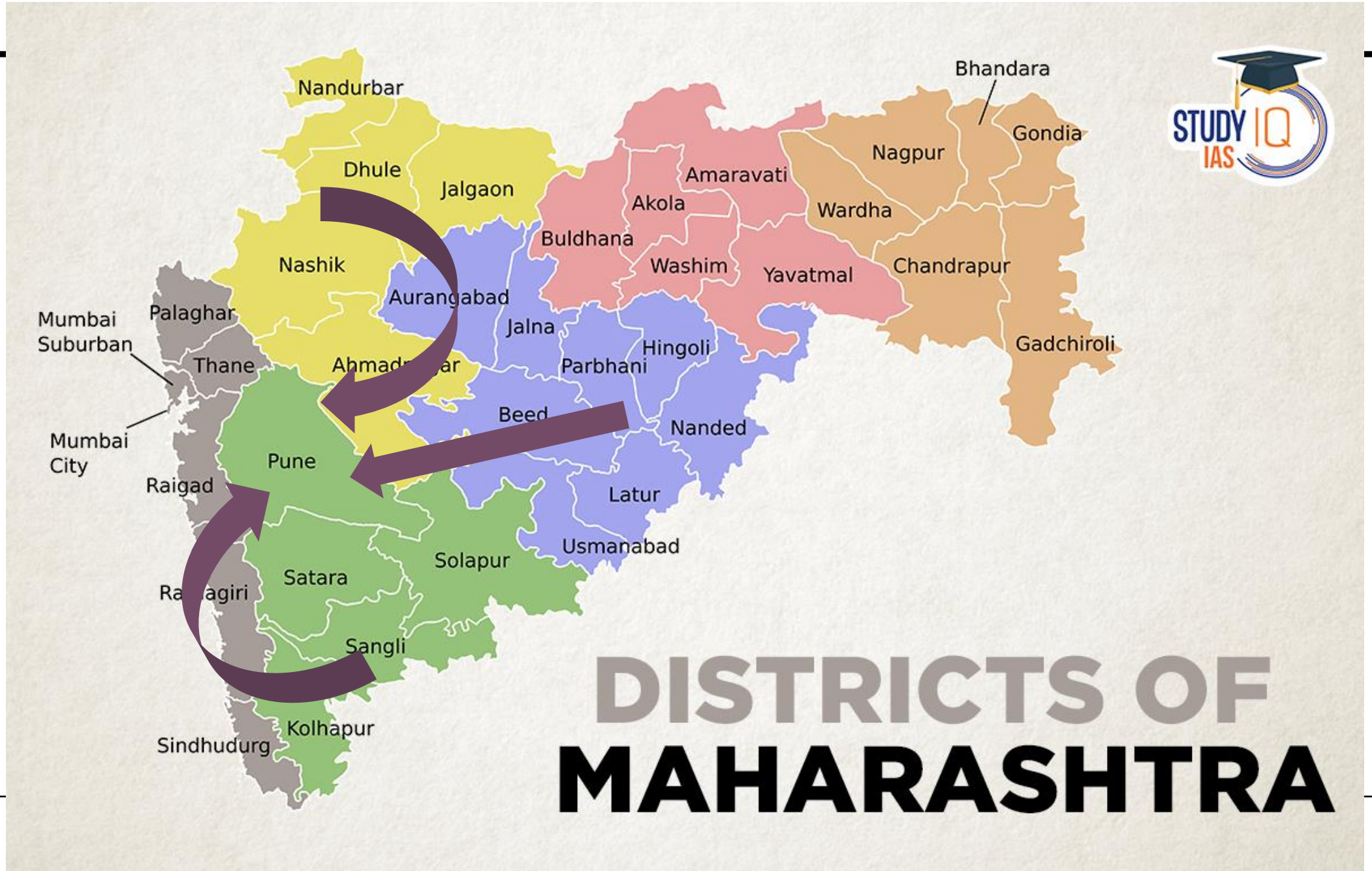



varian

SCOPE OF WORK

- Nearly 25,000 patients treated since 27.1.2005 on Linac




Nandurbar
Dhule
Jalgaon
Nashik
Palaghar
Mumbai Suburban
Thane
Mumbai City
Raigad
Pune
Satara
Sangli
Kolhapur
Sindhudurg
Aurangabad
Jalna
Beed
Parbhani
Hingoli
Nanded
Latur
Usmanabad
Solapur
Buldhana
Akola
Amaravati
Washim
Yavatmal
Wardha
Nagpur
Bhandara
Gondia
Chandrapur
Gadchiroli
STUDY IQ IAS
DISTRICTS OF
MAHARASHTRA

NEED FOR SGRT

1. High throughput
2. Significant breast radiotherapy with a huge load on Truebeam STx
3. Needed a dependable back up on Halcyon (no field lamp)
4. DIBH on Halcyon needed
5. 3D couch on Halcyon.
6. Need for tattoo-less system
7. Arm and chin verification for breast
8. Intrafraction motion management
9. Confident craniospinal irradiation
10. Better setups for extremities
11. More comfort for palliative patients

TECHNICAL CONSIDERATIONS WHILE MAKING THE CHOICE FOR SGRT

- In bore cameras for visualization of tricky areas
- Accurate calculations especially hidden areas
- Postural view for ease of setup- guidelines
- Versatile software
- Quick system
- Easily integrated into workflow
- Quick and easy QA
- No additional radiation dose

DRAWBACK

- Inability to Auto beam-hold with Halcyon
- External contour does not always correlate with internal anatomy
- Slow learning curve
- Open mask – change in work practice
- Sensitive to ROI

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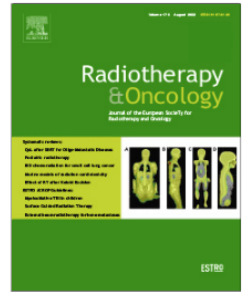
journal homepage: www.thegreenjournal.com

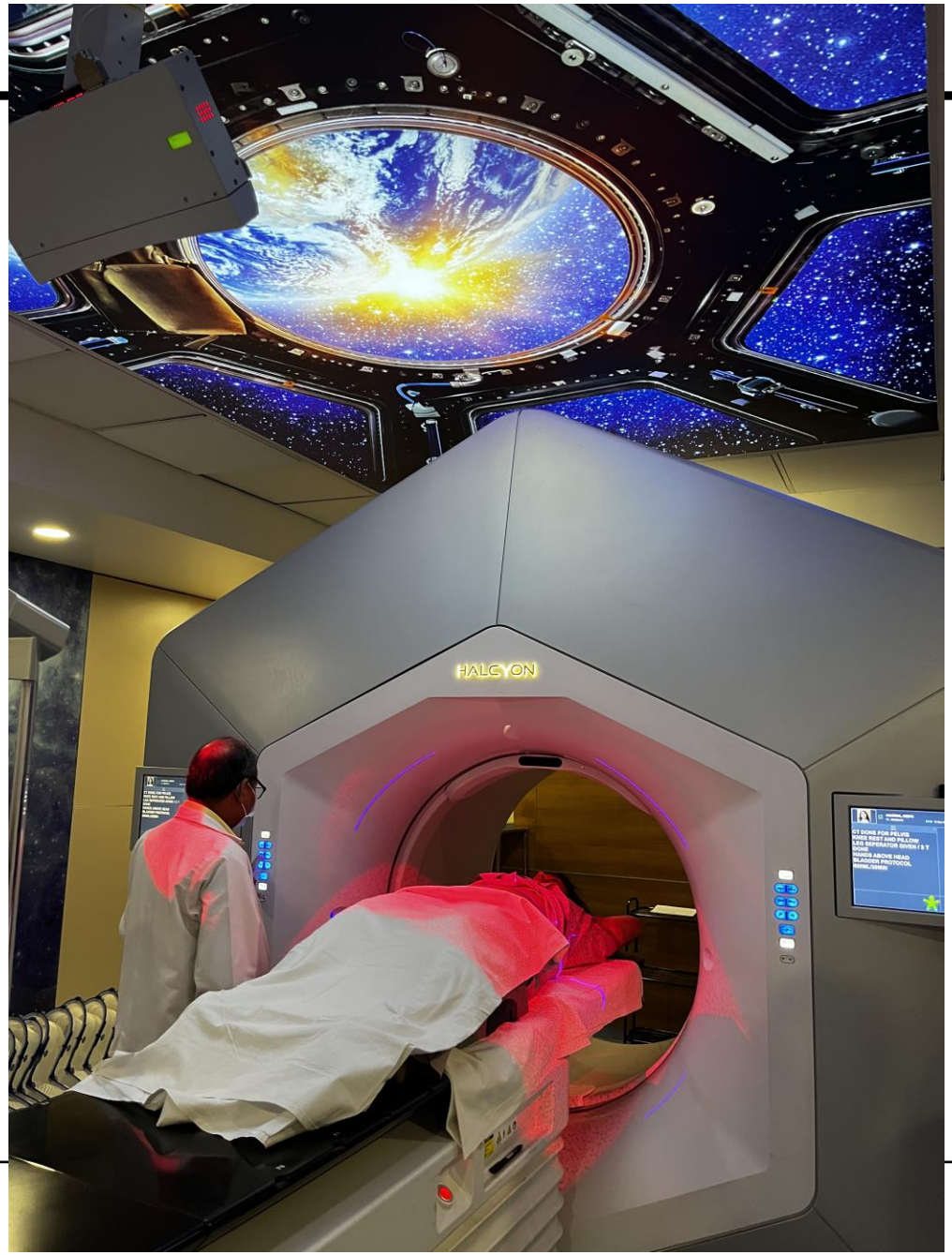


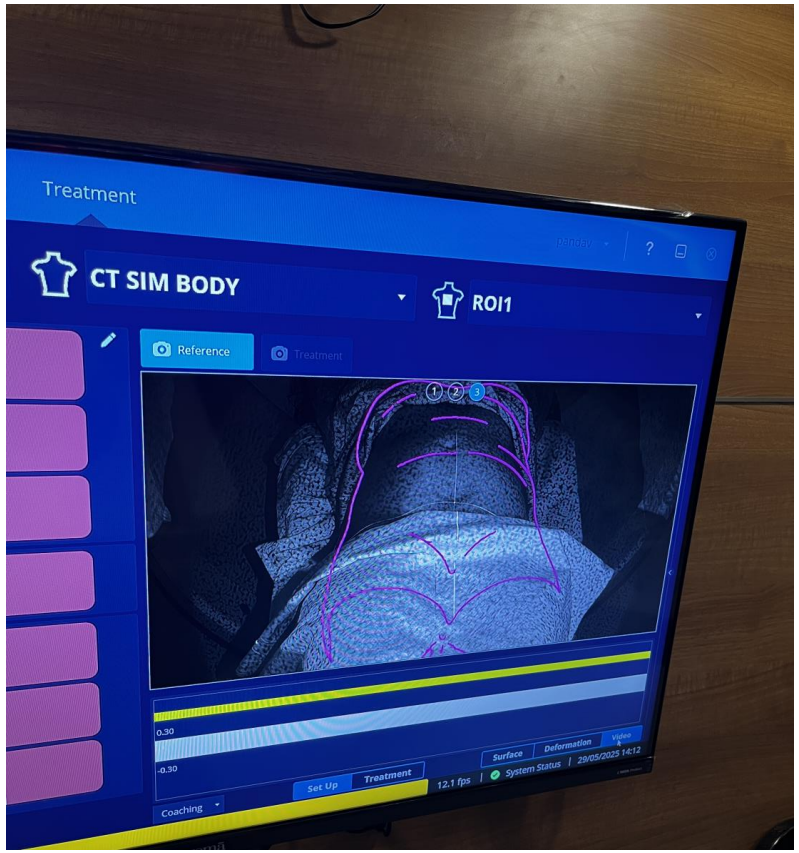
Guidelines

ESTRO-ACROP guideline on surface guided radiation therapy

P. Freislederer [a,1,*], V. Batista [b,c], M. Öllers [d], M. Buschmann [e], E. Steiner [f], M. Kügele [g], F. Fracchiolla [h], S. Corradini [a], M. de Smet [i], F. Moura [j], S. Perryck [k], F. Dionisi [l], D. Nguyen [m], C. Bert [n], J. Lehmann [o,p,q]

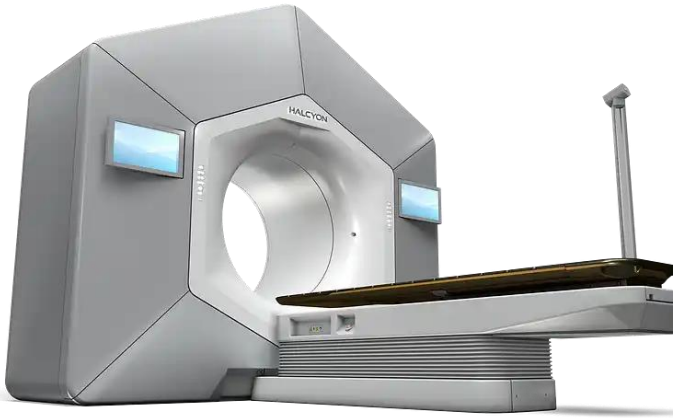
[a] *Department of Radiation Oncology, LMU University Hospital, Munich;* [b] *Department of Radiation Oncology, Heidelberg University Hospital;* [c] *Heidelberg Institute of Radiation Oncology (HIRO), Heidelberg;* [d] *Department of Radiotherapy, MAASTRO, Maastricht, The Netherlands;* [e] *Department of Radiation Oncology, Medical University of Vienna/AKH Wien;* [f] *Institute for Radiation Oncology and Radiotherapy, Landesklinikum Wiener Neustadt;* [g] *Department of Hematology, Oncology and Radiation Physics, Skåne University Hospital, Lund, Sweden;* [h] *Azienda Provinciale per i Servizi Sanitari (APSS) Protontherapy Department, Trento, Italy;* [i] *Department of Medical Physics & Instrumentation, Institute Verbeeten, Tilburg, The Netherlands;* [j] *Hospital CUF Descobertas, Department of Radiation Oncology, Lisbon, Portugal;* [k] *Department of Radiation Oncology, University Hospital Zürich, Switzerland;* [l] *Department of Radiation Oncology, IRCCS Regina Elena National Cancer Institute, Rome, Italy;* [m] *Centre de Radiothérapie de Mâcon, France;* [n] *Department of Radiation Oncology, Universitätsklinikum Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany;* [o] *Radiation Oncology Department, Calvary Mater Newcastle;* [p] *School of Information and Physical Sciences, University of Newcastle; and* [q] *Institute of Medical Physics, University of Sydney, Australia*


HALCYON


Treatment
CT SIM BODY
ROI1
Reference
Treatment
0.30
-0.30
Surface
Deformation
Video
Set Up
Treatment
12.1 fps
System Status
29/05/2025 14:12
Coaching

INITIAL EXPERIENCE

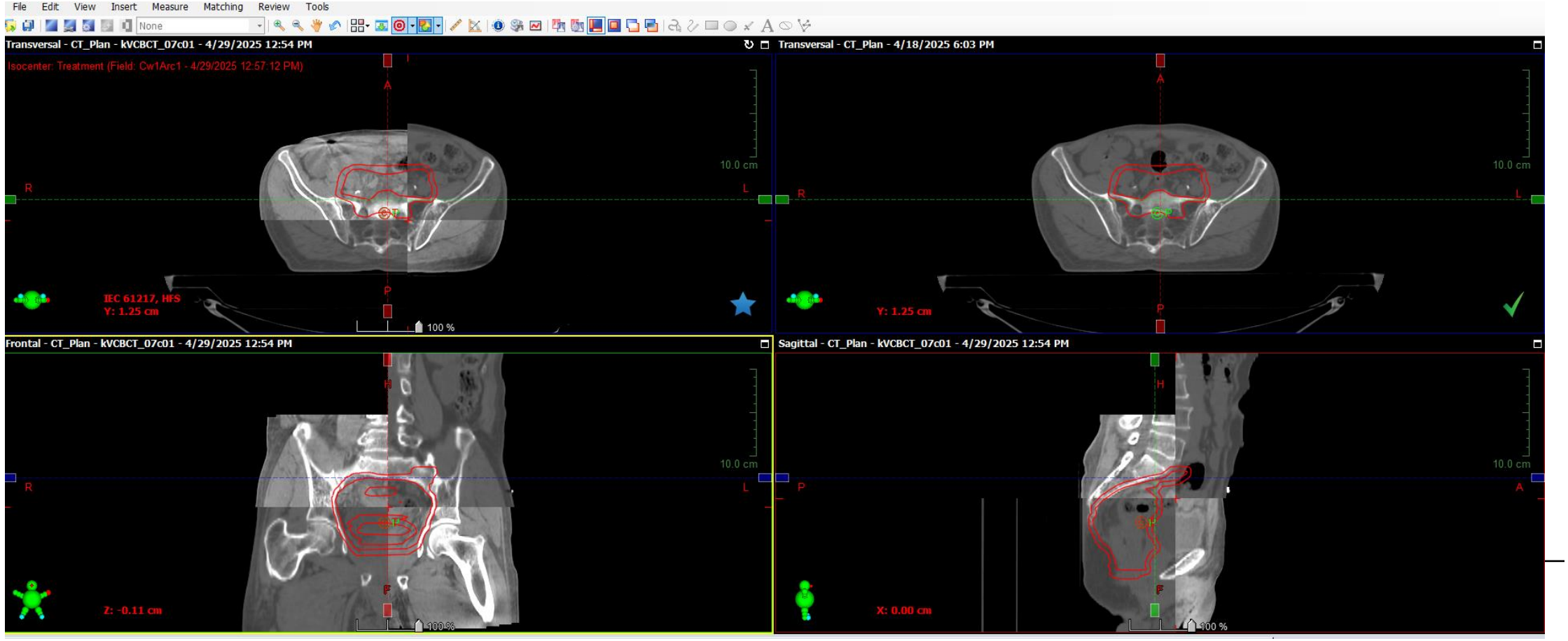
- Breast
- Extremity
- Thorax
- Pelvis
- Head neck



RESIDUAL ROTATIONAL ERRORS WITH AND WITHOUT SURFACE GUIDED SETUP IN PATIENTS RECEIVING PELVIC RADIOTHERAPY

HYPOTHESIS

- Rotational errors will reduce after setup with surface guidance.



BACKGROUND

- Halcyon Elite does not allow for correction of rotational errors.

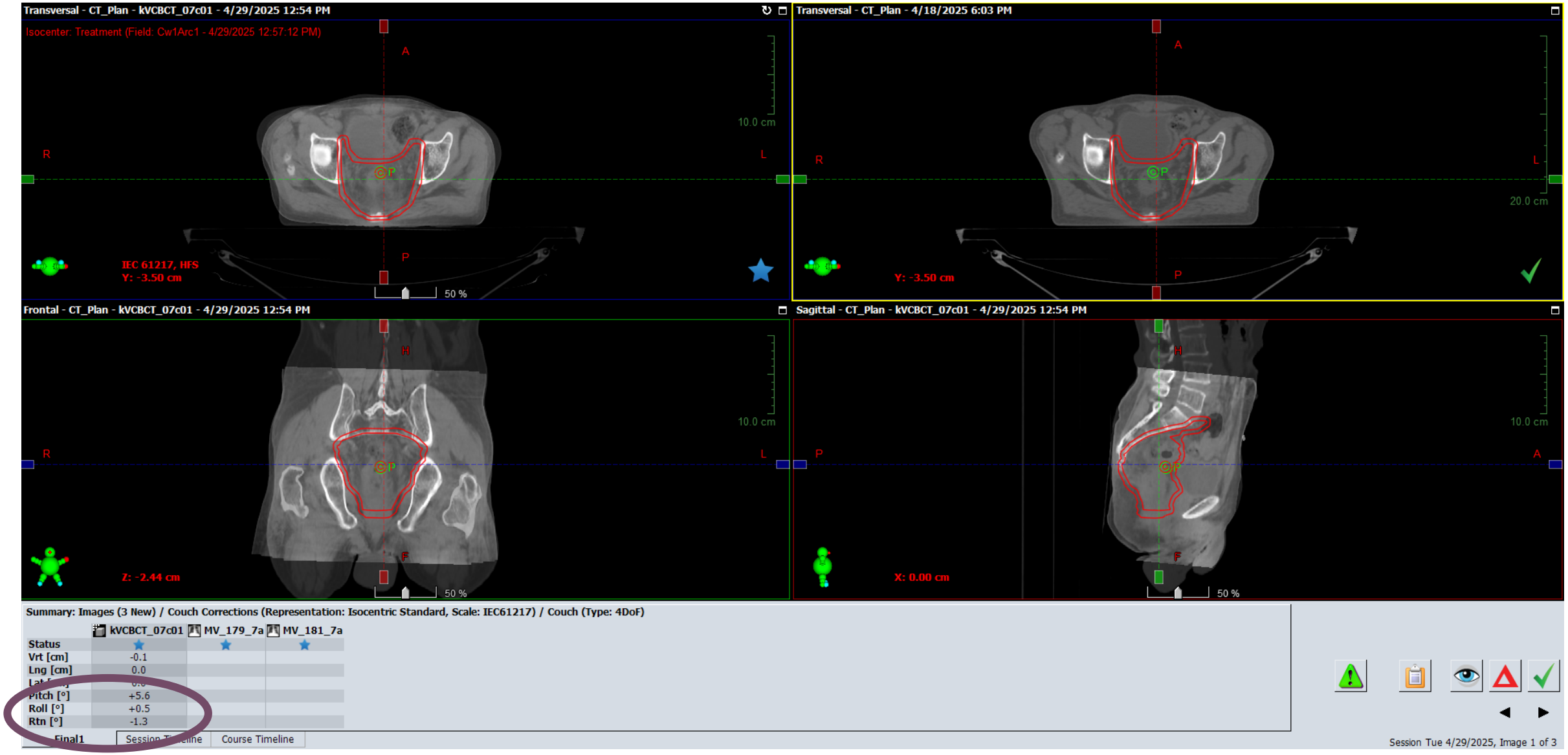
Rep Pract Oncol Radiother. 2024 Feb 16;28(6):764–771. doi: 10.5603/rpor.98733

Surface-guided radiotherapy improves rotational accuracy in gynecological cancer patients

Mimmi-Caroline Bolin [1,✉], Marianne Falk [1], Mattias Hedman [2,3], Giovanna Gagliardi [1,3], Eva Onjukka [1,3]

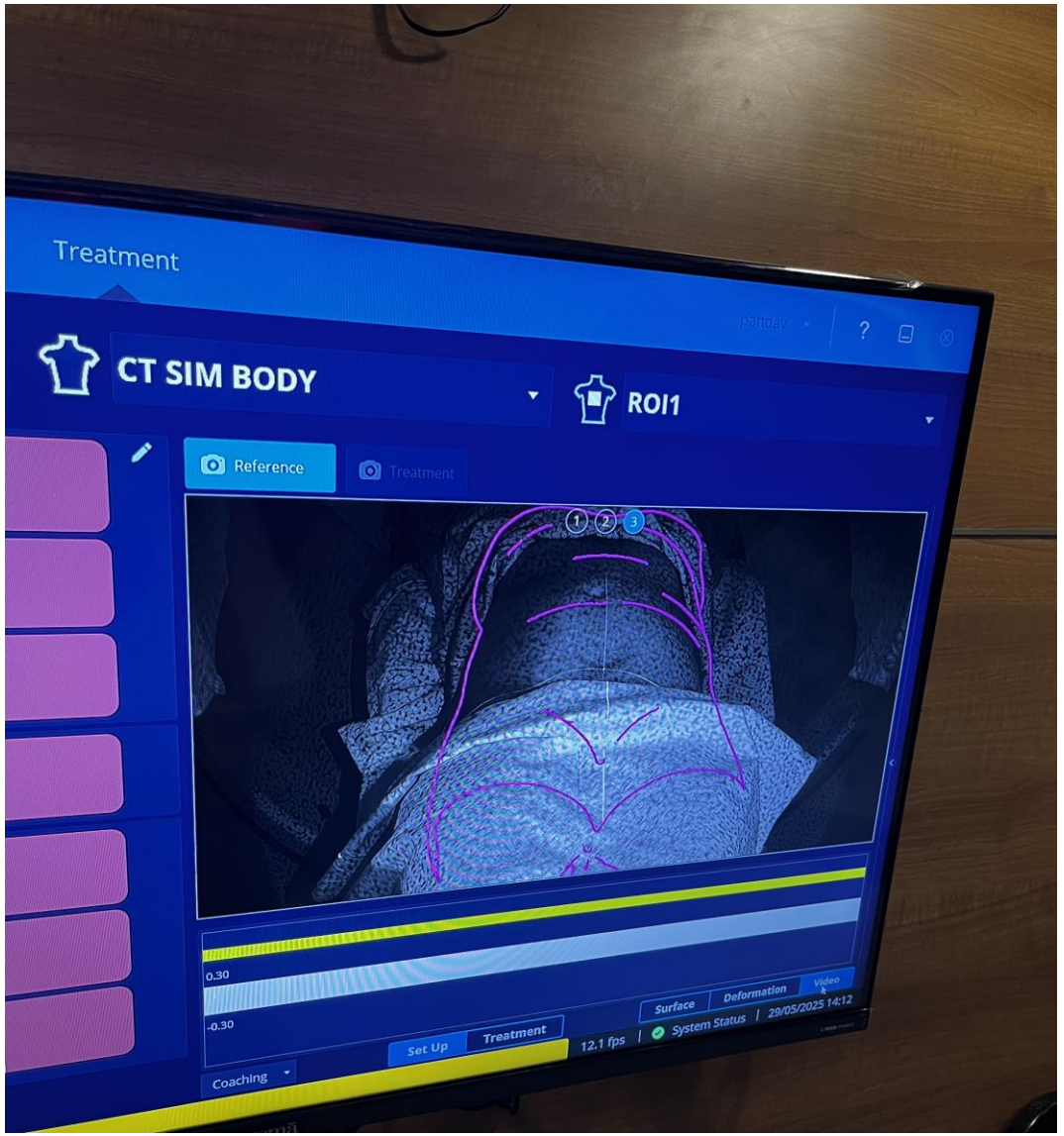
Author information Article notes Copyright and License information

PMCID: PMC10954265 PMID: 38515814


Transversal - CT_Plan - kVCBCT_07c01 - 4/29/2025 12:54 PM
Isocenter: Treatment (Field: Cw1Arc1 - 4/29/2025 12:57:12 PM)
A
R
L
P
10.0 cm
IEC 61217, HFS
Y: -3.50 cm
50 %
Transversal - CT_Plan - 4/18/2025 6:03 PM
A
R
L
P
20.0 cm
Y: -3.50 cm
Frontal - CT_Plan - kVCBCT_07c01 - 4/29/2025 12:54 PM
H
R
L
F
10.0 cm
Z: -2.44 cm
50 %
Sagittal - CT_Plan - kVCBCT_07c01 - 4/29/2025 12:54 PM
H
P
A
F
10.0 cm
X: 0.00 cm
50 %
Summary: Images (3 New) / Couch Corrections (Representation: Isocentric Standard, Scale: IEC61217) / Couch (Type: 4DoF)
kVCBCT_07c01
MV_179_7a
MV_181_7a
Status
Vrt [cm] -0.1
Lng [cm] 0.0
Pitch [°] +5.6
Roll [°] +0.5
Rtn [°] -1.3
Final1
Session Timeline
Course Timeline
Session Tue 4/29/2025, Image 1 of 3

METHODOLOGY

- Retrospective study.
- A cohort of 18 patients undergoing pelvic radiotherapy was identified.
- For each patient had 4-5 treatments were selected with and without “setup with surface guidance”.
- CBCT was analyzed in offline review and translational and rotational errors (6D) were noted.
- Mean , Median and Standard Deviation was calculated.
- The mean values of rotational errors between SGRT and non SGRT group were compared using paired T test.




sert
Measure
Matching
Review
Tools
None
kVCBCT_12p01 - 5/7/2025 2:00 PM
eld: Cw1Arc1 - 5/7/2025 2:03:20 PM)
Transversal - CT_Plan - 4/18/2025 6:03 PM
10.0 cm
100 %
Y: 1.25 cm
BCT_12p01 - 5/7/2025 2:00 PM
Sagittal - CT_Plan - kVCBCT_12p01 - 5/7/2025 2:00 PM
X: 0.00 cm


Insert
Measure
Matching
Review
Tools
None
- kVCBCT_06j01 - 4/28/2025 2:15 PM
Field: Cw1Arc1 - 4/28/2025 2:17:20 PM)
Transversal - CT_Plan - 4/18/2025 6:03 PM
10.0 cm
100 %
Y: 1.25 cm
Sagittal - CT_Plan - kVCBCT_06j01 - 4/28/2025 2:15 PM
X: 0.00 cm

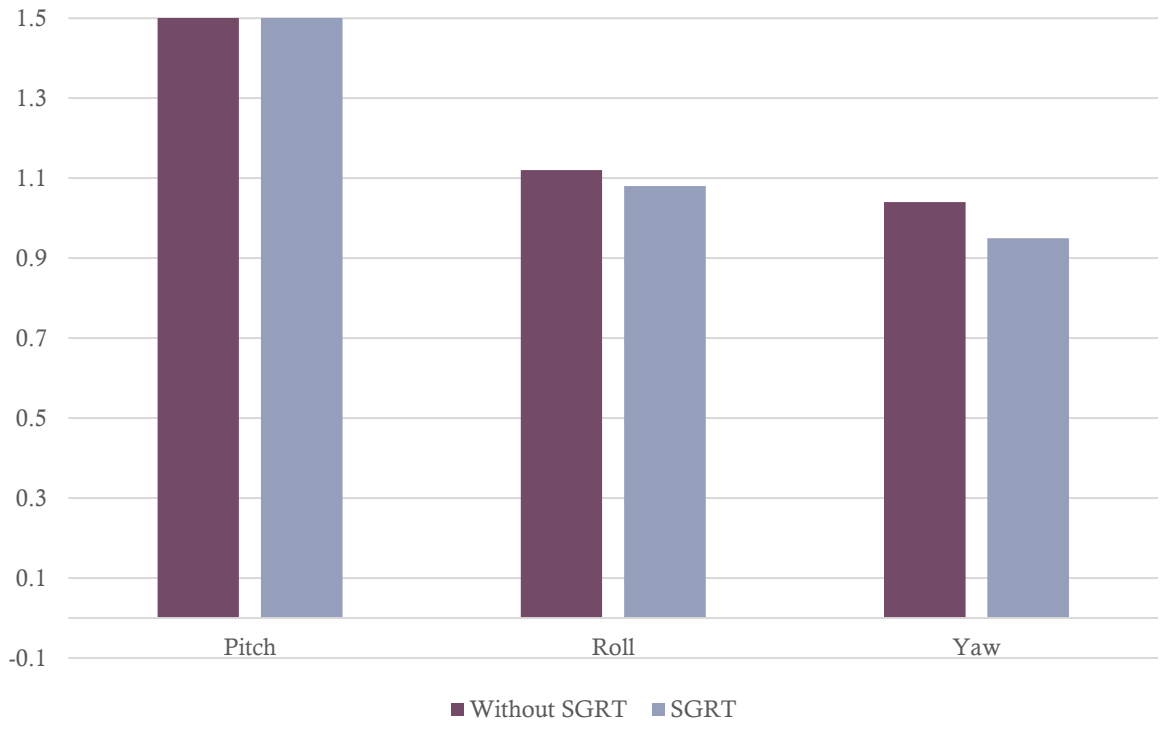
FINDINGS

- Sample size - 186 offline reviews belonging to 18 patients reviewed retrospectively

- Sites- Ca Rectum , Ca Endometrium , Ca cervix

Pitch	Without SGRT	**With SGRT**
Mean	2.15	**2.09**
SD	1.63	**1.43**
SE Diff	0.224	
CI	-0.38-0.5	
p value	0.79	
Roll		
Mean	1.12	**1.08**
SD	1.02	**0.87**
SE Diff	0.13	
CI	-0.2-0.3	
p value	0.77	
Yaw		
Mean	1.04	**0.95**
SD	0.82	**0.77**
SE Diff	0.11	
CI	-0.13-0.31	
p value	0.43	

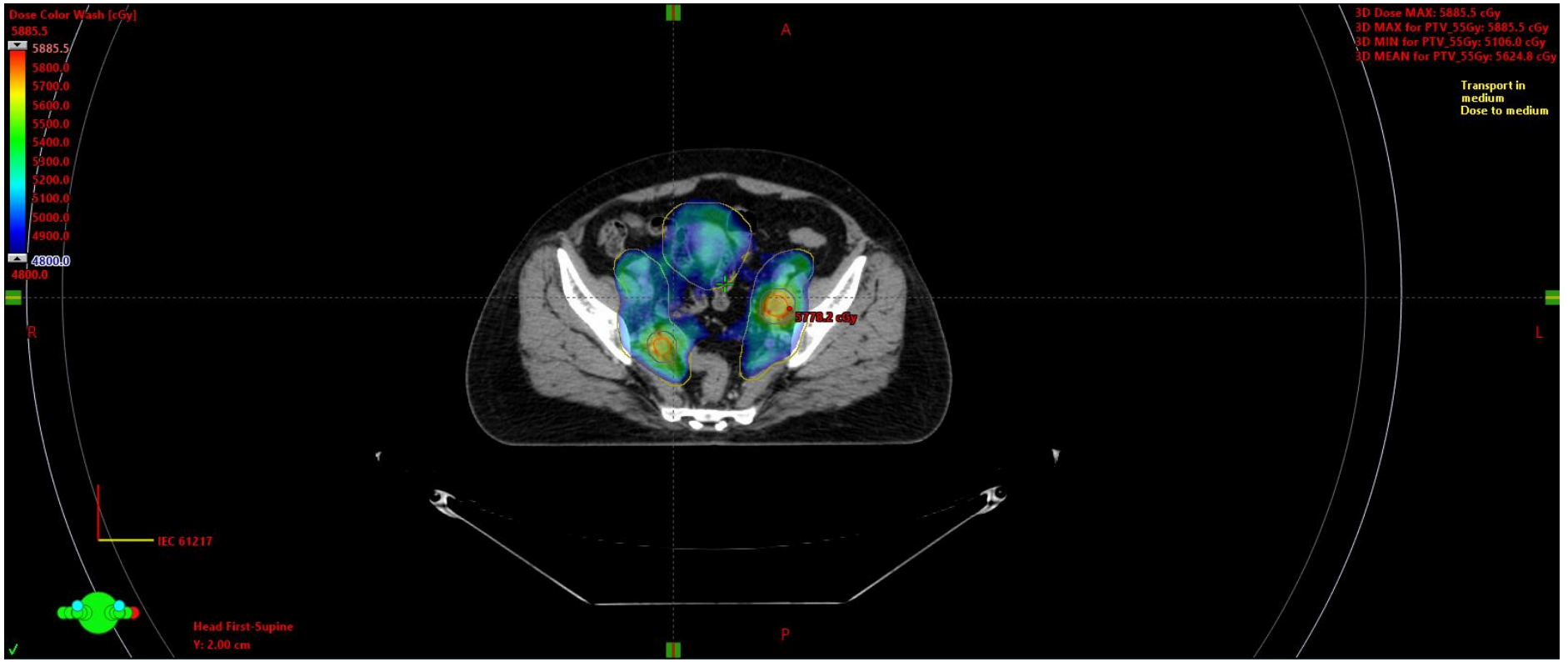
GRAPH

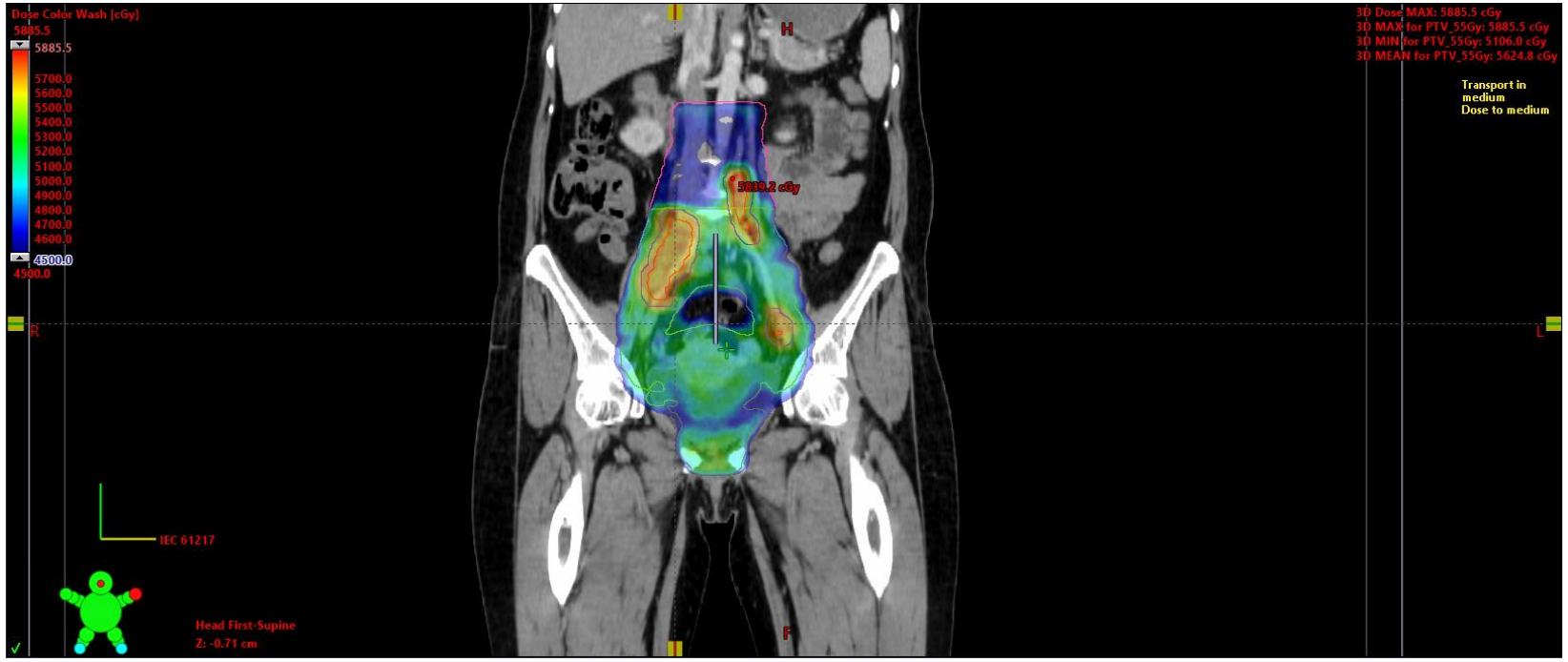


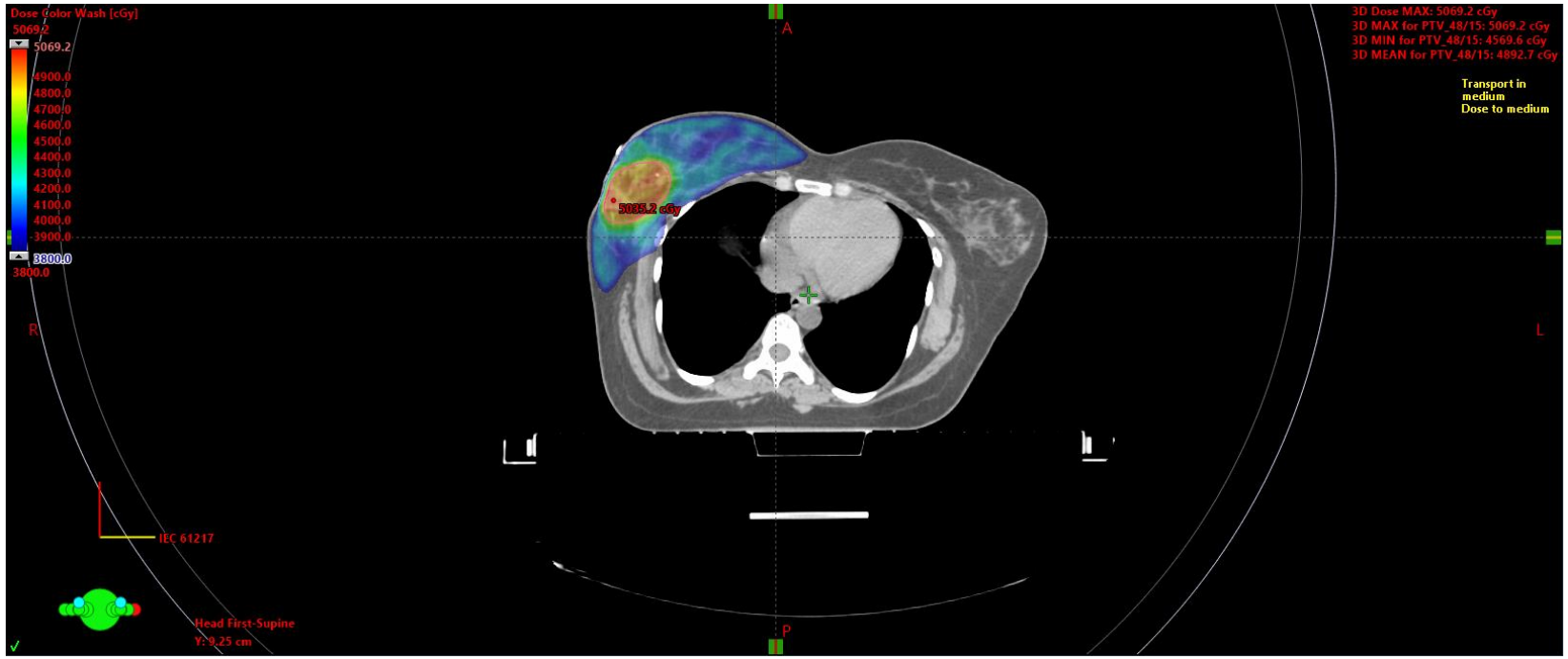
DISCUSSION

- Although p value is not statistically significant there was a trend to lower rotational values after using SGRT for setup.
- Likely to significantly benefit extended fields.
- Larger sample size required.
- The impact of rotational deviations on target dose coverage was not studied.
- Within technologist learning curve.
- Other advantages of SGRT remain


Transversal - CT_1 - kVCBCT_31j01 - 2/17/2025 11:05 AM
A
R
P
IEC 61217, HFS
Y: -4.50 cm
100 %
Sagittal - CT_1 - kVCBCT_31j01 - 2/17/2025 11:05 AM
H
F
20.0 Am
X: 0.00 cm
100 %
- kVCBCT_31j01 - 2/17/2025 11:05 AM
H
F
20.0 Lm
Z: -0.20 cm
100 %
Treatment values (Isocentric Standard, IEC61217)
Treatment beam
ID CW
Date/Time 2/17/2025 11:07:19 AM
Fraction 31
Treatment record
Image Treatment Difference
Couch Vrt -10.49 -9.98 +0.51 cm
Couch Lng +141.87 +141.70 -0.17 cm
Couch Lat -0.49 -0.42 +0.07 cm
Couch Pitch 0.0 357.4 -2.6 °
Couch Roll 0.0 357.2 -2.8 °
Couch Rtn 0.0 359.4 -0.6 °
Source Rtn 181.0 °
Coll Rtn 23.0 °
Close


Dose Color Wash [cGy]
5885.5
5885.5
5800.0
5700.0
5600.0
5500.0
5400.0
5300.0
5200.0
5100.0
5000.0
4900.0
4800.0
4800.0
A
R
L
P
5771.2 cGy
3D Dose MAX: 5885.5 cGy
3D MAX for PTV_55Gy: 5885.5 cGy
3D MIN for PTV_55Gy: 5106.0 cGy
3D MEAN for PTV_55Gy: 5624.8 cGy
Transport in medium
Dose to medium
IEC 61217
Head First-Supine
Y: 2.00 cm


Dose Color Wash [cGy]
5885.5
5885.5
5700.0
5600.0
5500.0
5400.0
5300.0
5200.0
5100.0
5000.0
4900.0
4800.0
4700.0
4600.0
4500.0
4500.0
3D Dose MAX: 5885.5 cGy
3D MAX for PTV_55Gy: 5885.5 cGy
3D MIN for PTV_55Gy: 5106.0 cGy
3D MEAN for PTV_55Gy: 5624.8 cGy
Transport in medium
Dose to medium
5839.2 cGy
H
F
R
L
IEC 61217
Head First-Supine
Z: -0.71 cm


Dose Color Wash [cGy]
5069.2
5069.2
4900.0
4800.0
4700.0
4600.0
4500.0
4400.0
4300.0
4200.0
4100.0
4000.0
3900.0
3800.0
3800.0
A
P
R
L
5025.2 cGy
3D Dose MAX: 5069.2 cGy
3D MAX for PTV_48/15: 5069.2 cGy
3D MIN for PTV_48/15: 4569.6 cGy
3D MEAN for PTV_48/15: 4892.7 cGy
Transport in medium
Dose to medium
IEC 61217
Head First-Supine
Y: 9.25 cm

FUTURE APPLICATIONS

- Autobeam hold on Halcyon
- Vision RT in Truebeam (autobeam hold)
- Dose RT
- Institutional PTV calculations

VAN HERKS FORMULA

$$M = A\,\Sigma + B\,\mathbf{\Sigma\_INTER^2} + \mathbf{\Sigma\_INTRA^2} + \Sigma\_P^2 - B\,\Sigma\_P + GM$$

- **M**: is the PTV margin.
- **α**: and β are coefficients (often 2.5 and 1.64, respectively).
- **Σ**: is the standard deviation of the systematic error (e.g., due to setup variation).
- **σ_inter**: is the standard deviation of inter-fractional motion.
- **σ_intra**: is the standard deviation of intra-fractional motion.
- **σ_p**: is the standard deviation of the dose penumbra (blurring).
- **GM**: represents the geometric margin

THANK YOU!

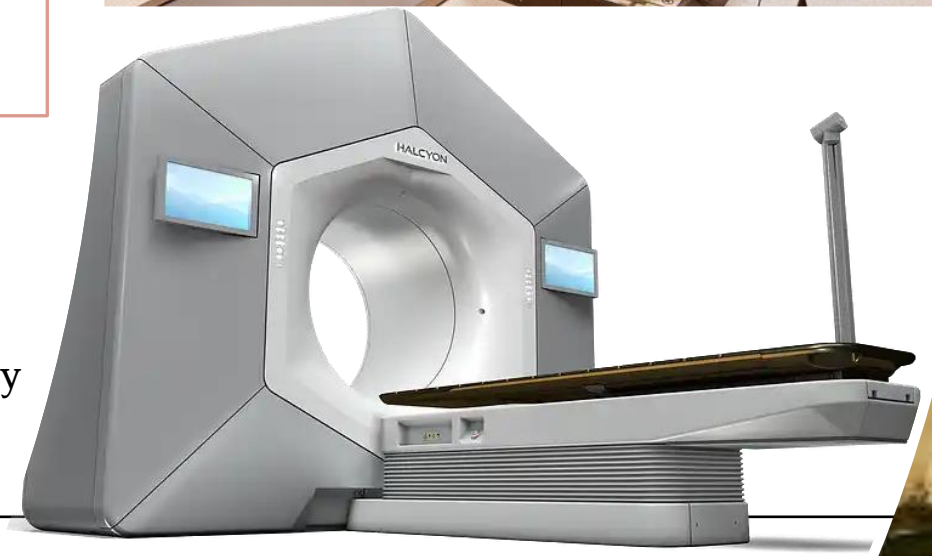
Special thanks to :

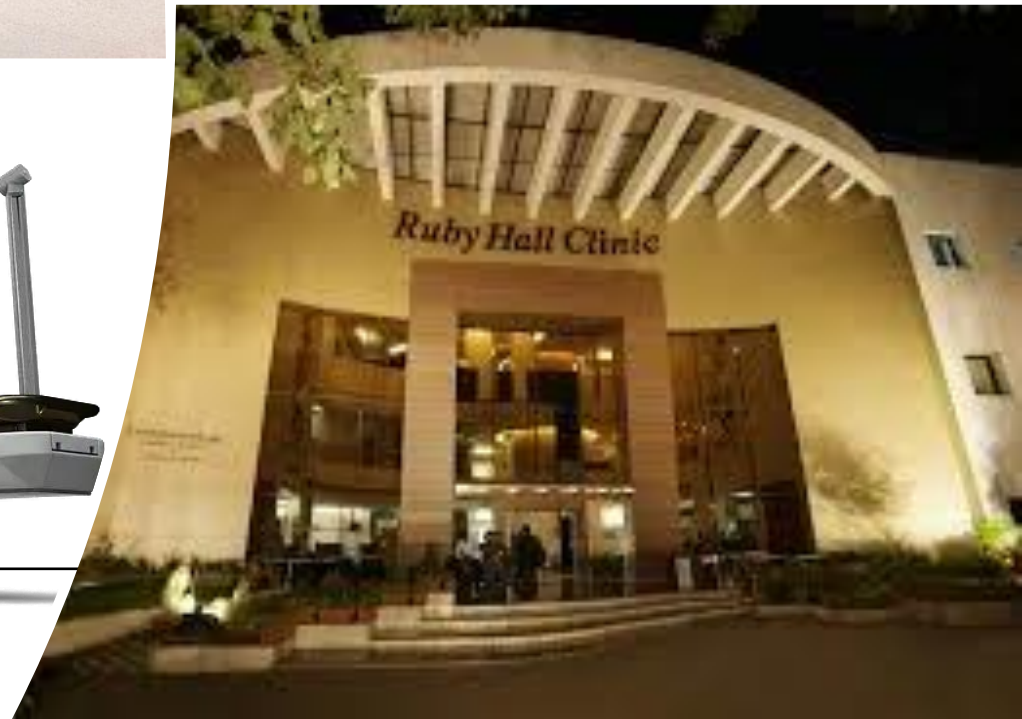
Dr Zade, Dr Mutha, Dr Dhingra

Dr Sathiyanarayan, Dr Holla

Dr Niraj Dhawale, Dr Anubhav P

Physics and RTT teams





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