Prostate SBRT

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The main course

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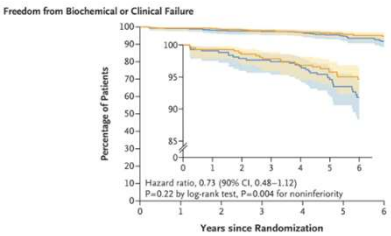
Level I evidence

PACE-B

- 36.25 Gy/**5#** vs. 78 Gy/39# or 62 Gy/20
- T1/T2
- ISUP 1 or ISUP 2
- PSA < 20 ng/mL
- 8% LR – **82% IR**
- **No ADT**

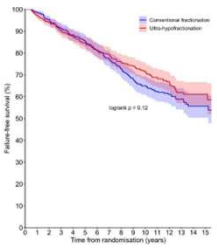


5y-results
Non-inferiority

van As et al. NEJM 2024

HYPO-RT-PC

- 42.7 Gy/**7#** vs. 78 Gy/39#
- T1c-T3a N0M0
- cT3a or ≥ ISUP 2 or PSA ≥ 10 ng/mL
- PSA < 20 ng/mL
- **89% IR** – 11% HR
- **No ADT**



10y-results
Non-inferiority

Thellenberg-Karlsson et al. ESTRO 2025

Indication | Motion | Simulation | Delineation | Planning | IGRT | Outcome

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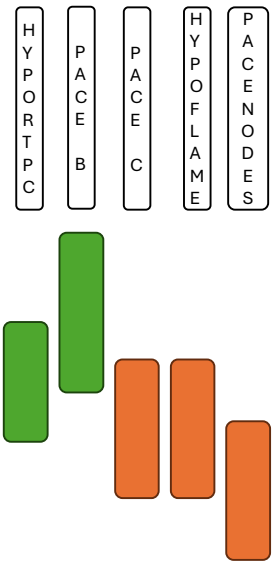
Level I evidence

NCCN risk group	Criteria	cT-stage	Biopsy GG	PSA (ng/mL)	% positive cores	Other	N	M
Very low	Must meet all	T1c	GG1	< 10	< 3 cores ≤ 50% cancer/core	PSA density < 0.15 ng/ml/g	0	0
Low	Must meet all, not v low	T1c-T2a	GG1	< 10			0	0
Favorable intermediate	All of: Only 1 IRF, GG1-2, <50% cores +	T1c T2b-c (this also is an IRF)	GG1-2, no 3	≥ 10 - ≤ 20 (this also is an IRF)		Intermediate risk factors (IRFs) are: cT2b-cT2c GG2-3 PSA 10-20	0	0
Unfavorable intermediate	Any: GG3, or ≥ 50% cores +, or 2+ IRFs		Any GG3		≥ 50% + (eg, ≥6/12 cores)		0	0
High	1 of these, but does not meet criteria for v high	cT3-T4	GG4-5	> 20			0	0
Very high (from STAMPEDE)	At least 2 of: cT3-4, GG4-5, PSA > 40	cT3-T4	GG4-5	>40			0	0
Regional	If N1 M0						1	0
Metastatic	If M1						Any	1



Indication | Motion | Simulation | Delineation | Planning | IGRT | Outcome

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Primary PCa

Patient selection

- Baseline urinary function
  - IPSS < 11
  - IPSS 11-19
  - IPSS > 19
- Prostate size
  - > 80-100 cc?
- Prior BPH surgery
  - Waiting period
- Bilateral hip replacements

Indication | Motion | Simulation | Delineation | Planning | IGRT | Outcome

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Motion

Interfraction
- **Low number** of fractions
- Reduced **statistical averaging**
- Systematic errors (setup/positioning)
- Random errors (day-to-day variation)

Image guided radiotherapy

Intrafraction
- Bladder filling
- Rectal filling

Real time monitoring ~ PTV margins

By Courtesy of Robin De Roover

Indication | Motion | Simulation | Delineation | Planning | IGRT | Outcome

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The preparation phase

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CT Simulation

Patient preparation

- Bladder protocol
  - Drinking 300 – 500 mL; 30-60 minutes before RT
  - Refraining from urination 60-90 minutes prior to RT
  - Half full bladder (in case of longer treatments)
- Rectal protocol
  - Empty rectum (micro-enema)
- Immobilization
  - Limit hip's rotation
- CT San
  - Slice thickness ≤ 2 mm

Indication | Motion | **Simulation** | Delineation | Planning | IGRT | Outcome

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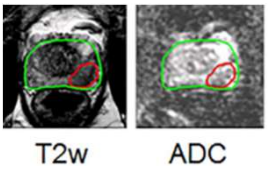
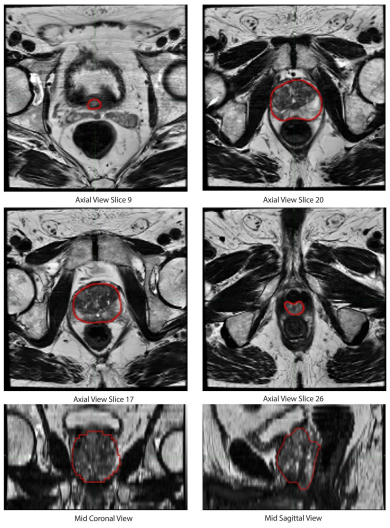
Delineation

Target volume delineation

- Minimum
  - Planning MRI
  - MRI-CT fusion
- Optional
  - GTV delineation (DWI, (DCE), PSMA-PET)





Indication | Motion | Simulation | **Delineation** | Planning | IGRT | Outcome

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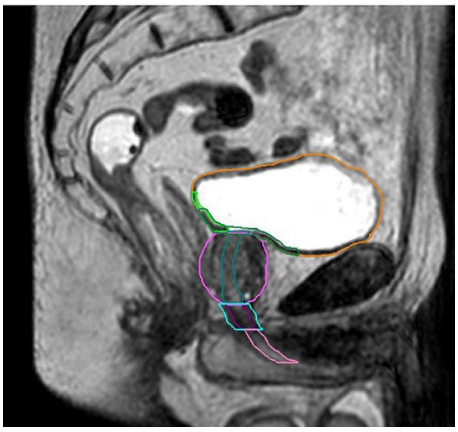
Delineation

OAR delineation

- Minimum
  - Rectum
  - Bladder
  - Urethra
  - Femoral head(s)
  - Bowel
- Optional
  - Bladder trigone
  - Sexual structures



Le Guévelou et al. PRO 2024

Indication | Motion | Simulation | **Delineation** | Planning | IGRT | Outcome

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Dose prescription

PACE-B

- 36.25 Gy / 7.25 Gy to 95% of the PTV
- 40 Gy / 8 Gy to 95% of the CTV

HYPO-RT-PC

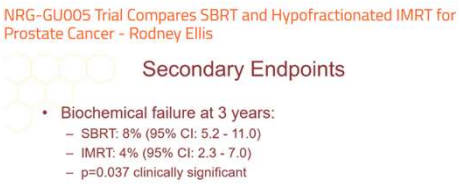
- 42.7 Gy / 6.4 Gy to the PTV (homogeneous)

FOCAL Boost trials

- 35 Gy – 36.25 Gy (5#) to the whole prostate gland
- 40 Gy – 50 Gy (5#) to the GTV

NRG-GU005

- 36.25 Gy / 7.25 Gy (5#) to the whole prostate gland
- Max PTV dose = 38.8 Gy



Ellis et al. ASTRO 2025

Indication | Motion | Simulation | Delineation | **Planning** | IGRT | Outcome

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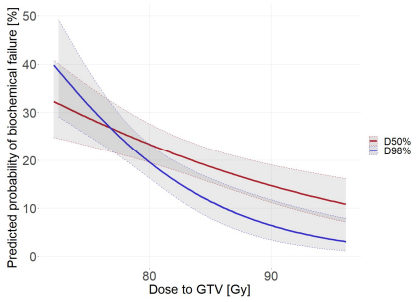
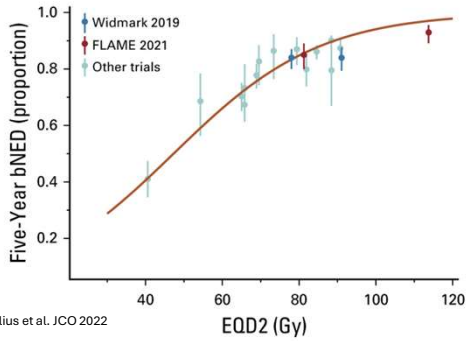
Dose prescription



Guricová et al. Radiother Oncol 2022



Vogelius et al. JCO 2022

Only 1 local recurrence dose > 81 Gy/35#
'high risk' population

Minimum GTV dose	EQD2 α/β-ratio = 3
45,0	108,0
42,5	97,8
40,0	88,0
37,5	78,8

Indication | Motion | Simulation | Delineation | **Planning** | IGRT | Outcome

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Dose prescription

Optimal dose ~ trial results

- PACE B = 'high' SBRT dose -> slightly **higher tox**; Perfect **oncological outcomes**
- NRG-GU 005 = 'low' SBRT dose -> slightly **lower tox**; Slightly **worse BCR**

- *3-year results*
- *NRG-GU 005 design = superiority*
- ***PSA-bounces** after SBRT (NRG-GU 005)?*

Solution?

- Focal boosting (w/ de-intensification of the normal prostate?)
- **…**

OTT

- Daily – EOD – Bi-weekly - Weekly

Indication | Motion | Simulation | Delineation | **Planning** | IGRT | Outcome

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Dose constraints

OARs	Dose constraint (Gy)	Volume	Notes	Source
Rectum	V18.1	50%	Mandatory	PACE-B
	V29	20%	Mandatory	PACE-B
	V36	2cc	Mandatory	PACE-B
	V36	1cc	Optimal	PACE-B
Bladder	V18.1	40 %	Mandatory	PACE-B
	V37	10cc	Mandatory	PACE-B
	V37	5cc	Optimal	PACE-B
Femoral heads	V14.5	5%	Mandatory	PACE-B
Bowel	V18.1	5cc	Mandatory	PACE-B
	V30	1cc	Mandatory	PACE-B
	<35	0.035cc	Mandatory	hypo-FLAME

Indication > Motion > Simulation > Delineation > **Planning** > IGRT > Outcome

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Dose constraints

OARs	Dose constraint (Gy)	Volume	Notes	Source
Prostatic urethra	V42	50%	Mandatory	PACE-B
	<42	0.035cc	Optimal	hypo-FLAME
Urethra-sparing	< 38	0.035cc	Optimal	No ref.
	<36	99%	Optimal	No ref.
Penile bulb	V29.5	50%	Mandatory	PACE-B
Crura	<4,7	Dmean	Optimal	Achard et al.
	<12	2%	Optimal	Achard et al.

Indication > Motion > Simulation > Delineation > **Planning** > IGRT > Outcome

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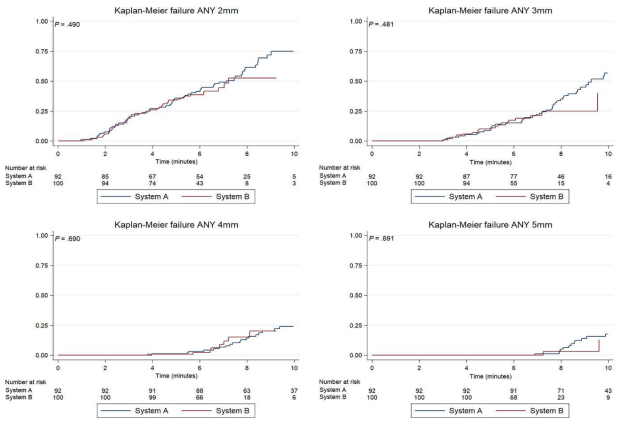
Planning

- PTV margin: 4-5mm
- PTV margin: 2-3mm ~ MR-LINAC, Cyberknife, …

- Reducing beam-on time = beneficial
- Minimize the number of arcs



Panizza et al. Med Phys 2025

Indication | Motion | Simulation | Delineation | **Planning** | IGRT | Outcome

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How to serve

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IGRT

Daily IGRT

- Minimum
  - CBCT soft tissue matching or fiducial marker based matching

- Optional (not used in the landmark trials for most patients)
  - Online fiducial marker tracking
  - Electromagnetic transponders (urethra)
  - MR-guide systems

Treatment time (per fraction)	PTV margin	CBCT soft-tissue matching or fiducial marker-based kV/MV systems	Intra-fraction monitoring
FAST (5- 10 minutes)	2-3 mm	☑	☑
	4-5 mm	☑	☒
PROLONGED (> 10 minutes)	2-3 mm	☑	☑
	4-5 mm	☑	☑

Indication | Motion | Simulation | Delineation | Planning | IGRT | Outcome

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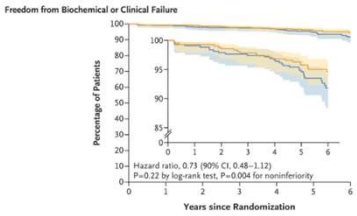
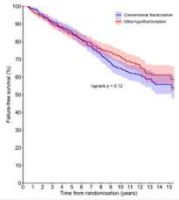
Results

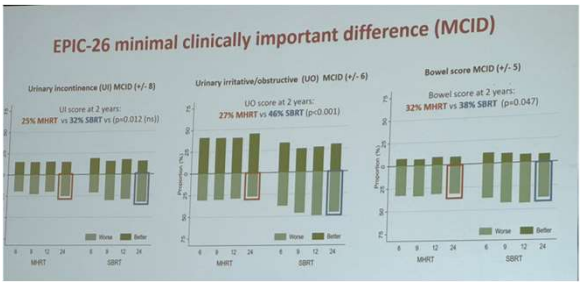
PACE-B (5y non-inf)



HYPO-RT-PC (10y non-inf)



PACE-C



Ratnakumaran et al. ASTRO 2025

Indication | Motion | Simulation | Delineation | Planning | IGRT | Outcome

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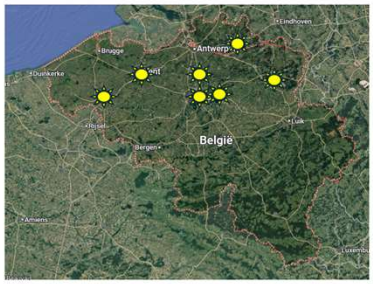
What's next?

Future in prostate SBRT

- De-intensification in lower risk PCa?
- Reducing the number of fractions?
- Prostate SBRT for higher risk PCa? (**PACE-C**)
- Focal boosting for higher risk PCa? (**hypo-FLAME 3.0**)



Indication | Motion | Simulation | Delineation | Planning | IGRT | **Outcome**

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Take-home Messages

- **SBRT is a standard of care for intermediate risk PCa**
- **Accurate motion management is crucial for treatment safety and efficacy**
- **Precise delineation and planning, ensure optimal balance between tumor control and toxicity**
- **Excellent oncological outcomes are demonstrated with prostate SBRT**
- **Acceptable toxicity outcomes are demonstrated with FU > 10y**

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Guidelines

- Ma TM, Ladbury C, Tran M, Keiper TD, Andraos T, Gogineni E, Mohideen N, Siva S, Loblaw A, Tree AC, Cheung P, Kresl J, Collins S, Cao M, Kishan AU. Stereotactic Body Radiation Therapy: A Radiosurgery Society Guide to the Treatment of Localized Prostate Cancer Illustrated by Challenging Cases. Pract Radiat Oncol. 2024 Mar-Apr;14(2):e117-e131. doi: 10.1016/j.prro.2023.08.011. Epub 2023 Sep 3. PMID: 37661040.
- Salembier C, Villeirs G, De Bari B, Hoskin P, Pieters BR, Van Vulpen M, Khoo V, Henry A, Bossi A, De Meerleer G, Fonteyne V. ESTRO ACROP consensus guideline on CT- and MRI-based target volume delineation for primary radiation therapy of localized prostate cancer. Radiother Oncol. 2018 Apr;127(1):49-61. doi: 10.1016/j.radonc.2018.01.014. PMID: 29496279.
- National Comprehensive Cancer Network. NCCN Clinical Practice Guidelines in Oncology: Prostate Cancer. Version 2.2026. 2026. https://www.nccn.org.
- How to perform Prostate SBRT: an ESTRO clinical practice guideline: coming soon

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