



MRI-guided radiotherapy for prostate cancer

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Prostate cancer

- Most common cancer in men in the Netherlands
- In 2020, 12,800 men received diagnosis prostate cancer

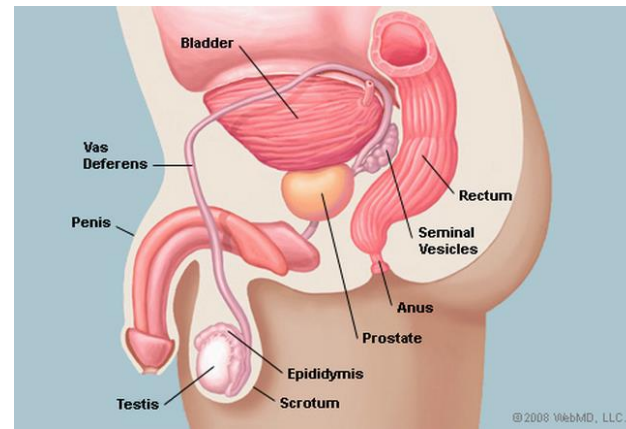


Prostaatkanker komt voor bij mannen vanaf ongeveer 45-jarige **leeftijd**, maar dit is zeldzaam en de diagnose wordt meestal gesteld bij mannen tussen de 60 en 80 jaar. De gemiddelde leeftijd bij diagnose is 70 jaar.



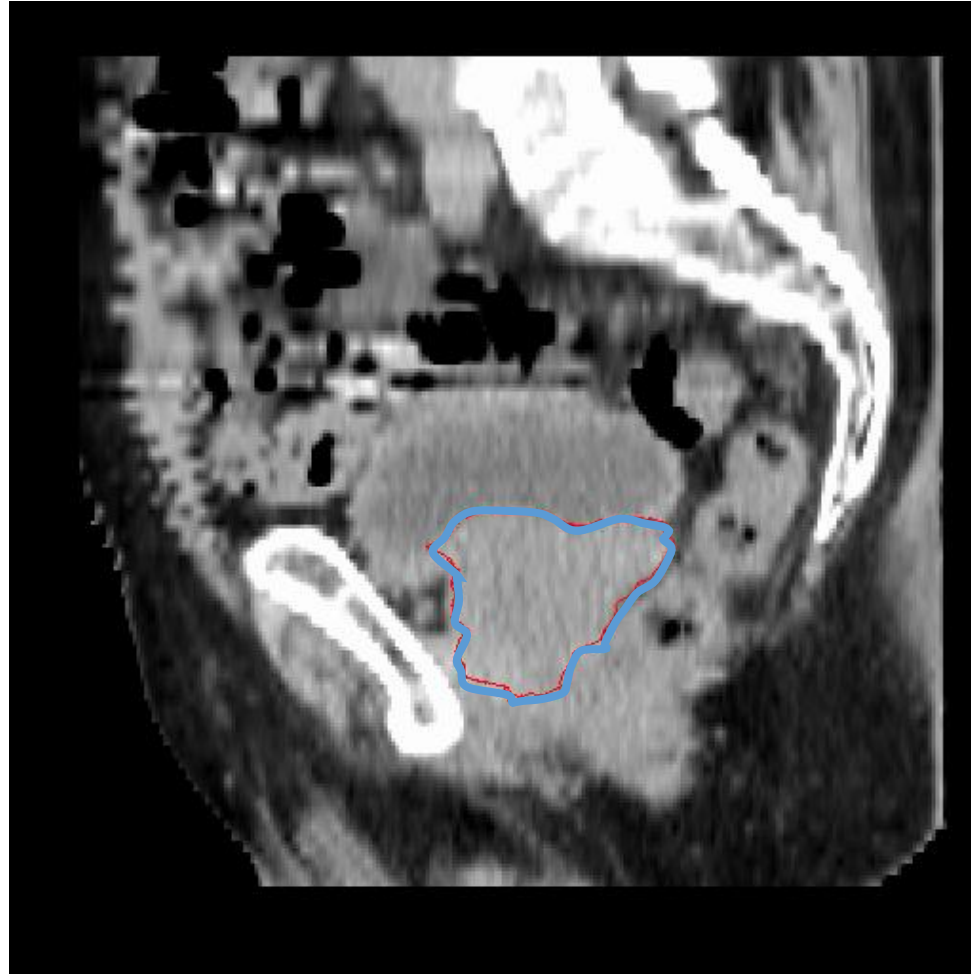
Side effects of radical treatment

- Operation (robot): erectile dysfunction and incontinence
 - After 1-year, 10% remains incontinent for urine



- Modern radiotherapy: mainly urinary and bowel symptoms

All organs and tumors move and change shape



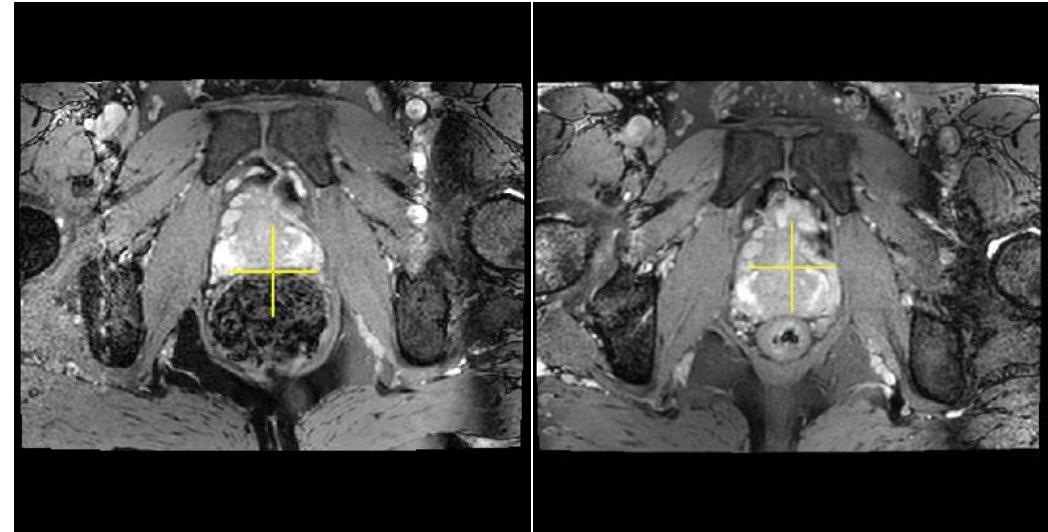
■ Prostate boundary

Fiducial marker, gold 5x1mm

- No rotations
- No deformations
- No seminal vesicles

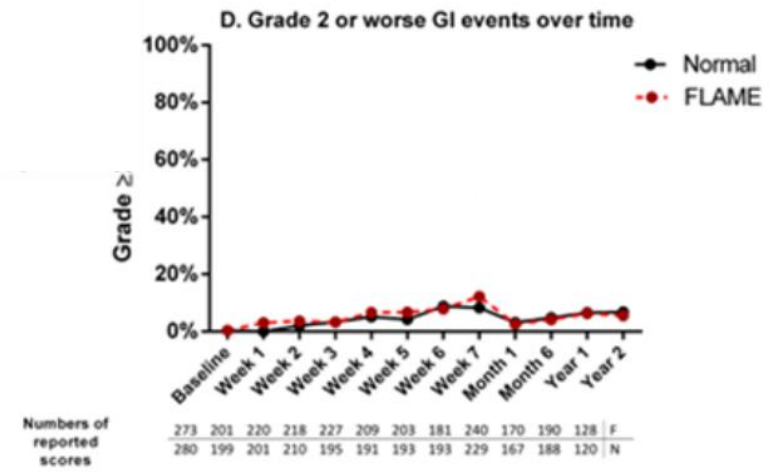
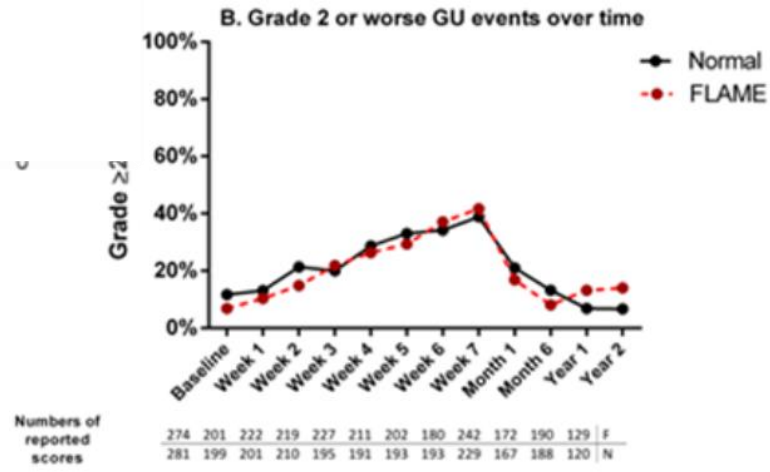


The MR-linac (Unity) “operate without a knife”



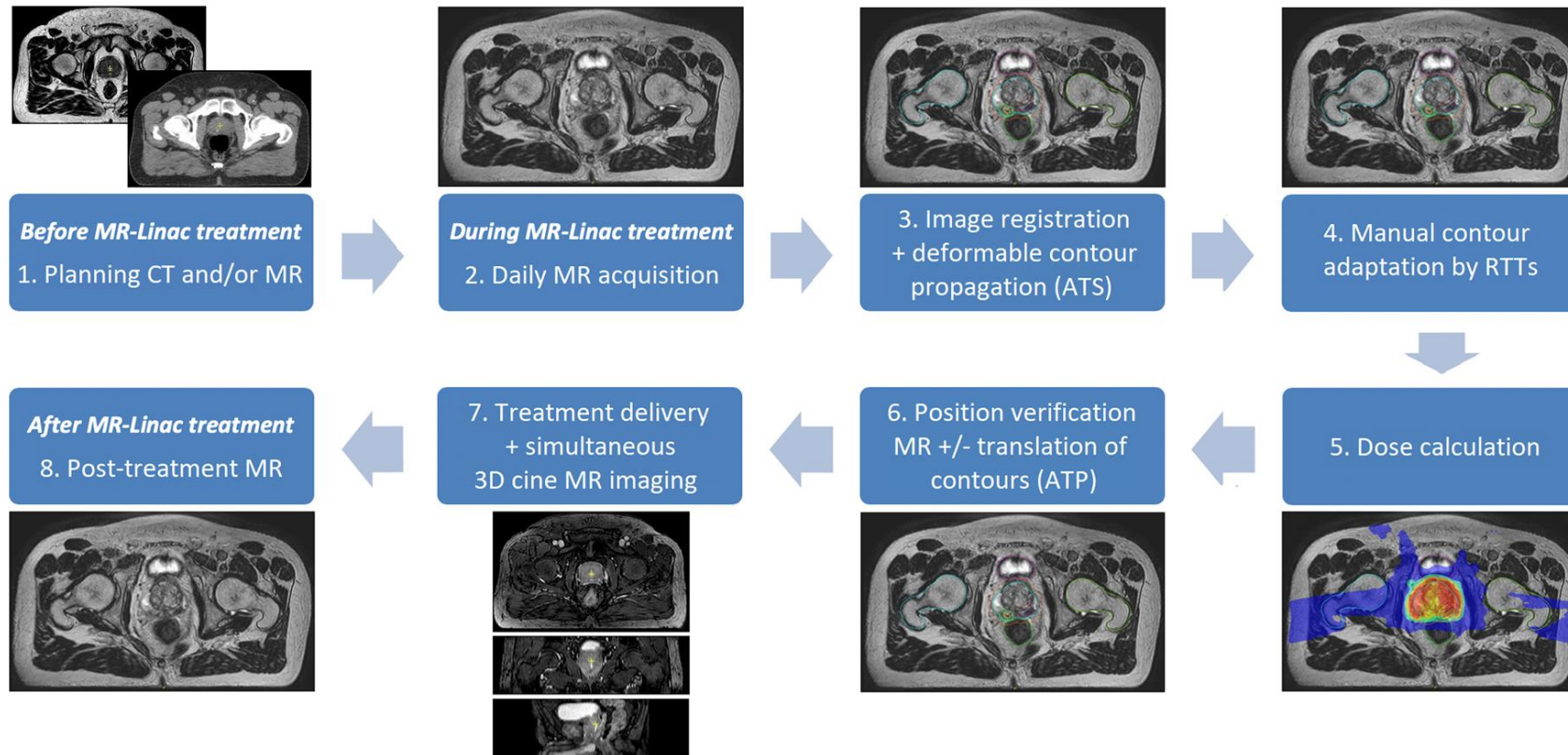
- Interfraction → new treatment plan for each treatment day
- Intrafraction (see real-time during treatment) → new plan for anatomy of the moment
 - Further reduction in grade ≥ 2 GU and GI toxicity

Toxicity FLAME-study



Workflow MR-Linac for prostate cancer treatment

n >400 patients treated on the MR-Linac



Funding



- Cohort

- Compare MR-Linac vs standard of care
(prostatectomy, radiotherapy and active surveillance)



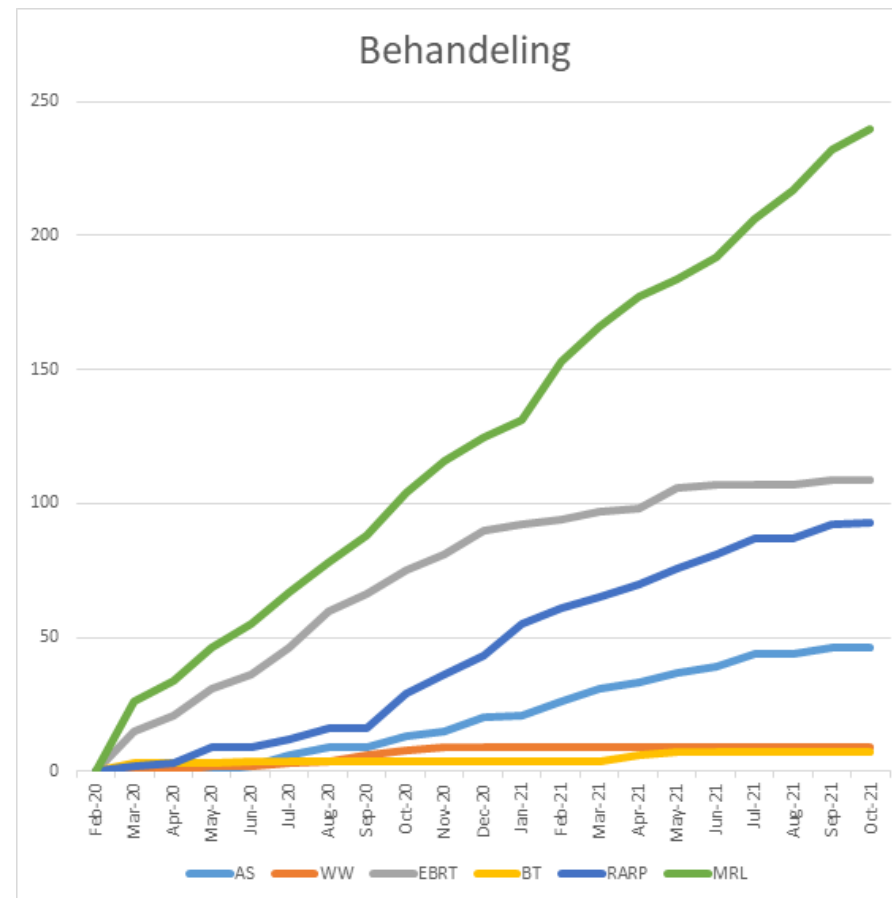
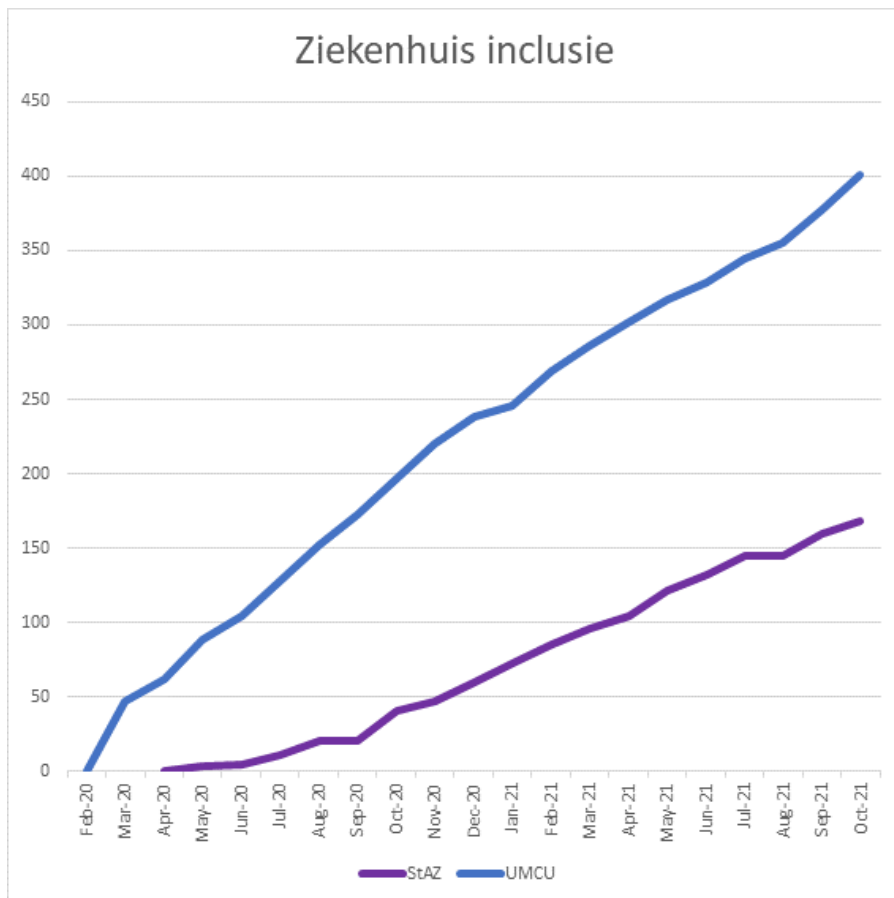
- Collect clinical, treatment and QOL data

- Technical developments MR-Linac

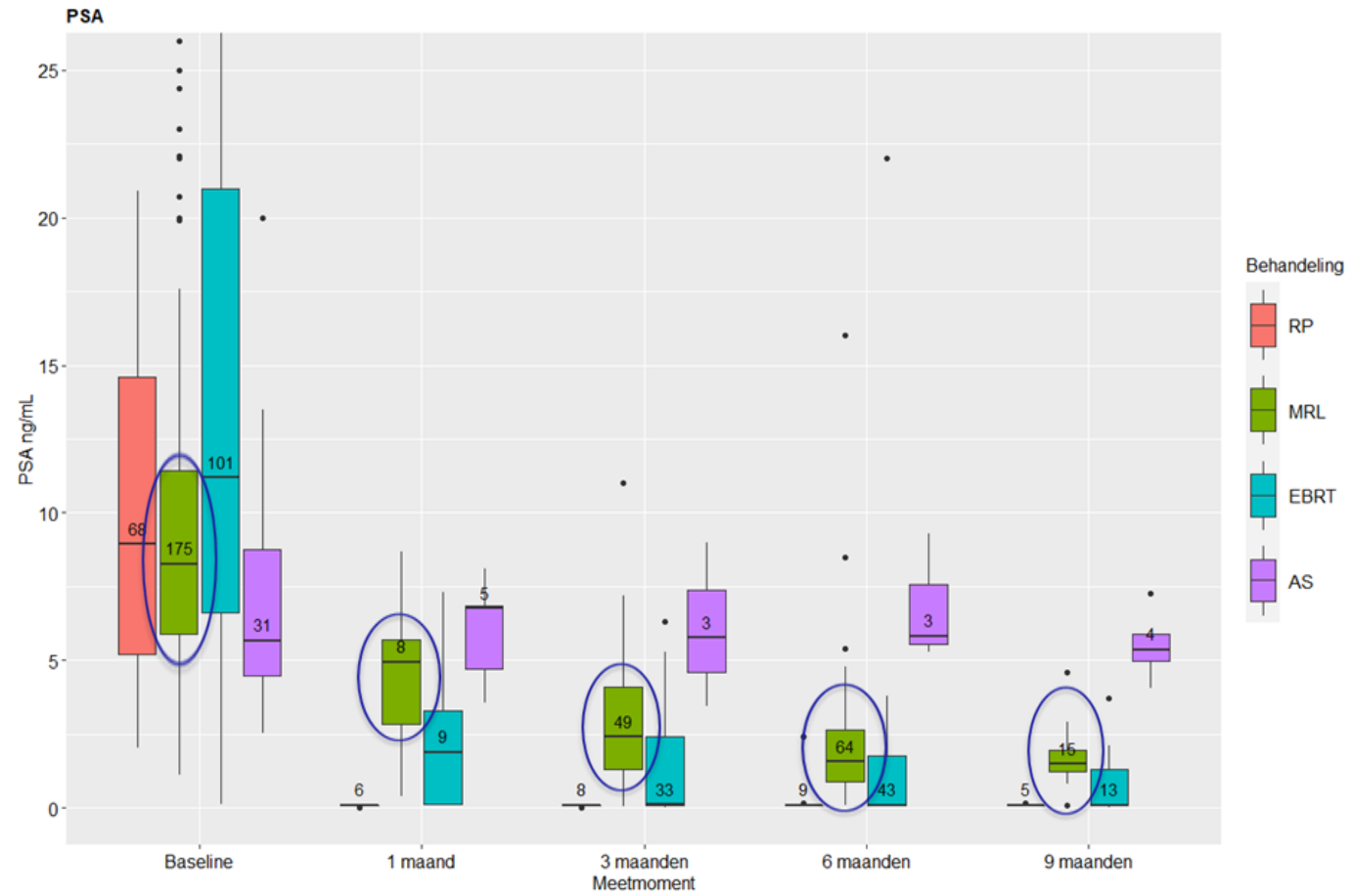
- Early economic health evaluation

- Cost-effectiveness (prospective)

Utrecht Prostate Cohort

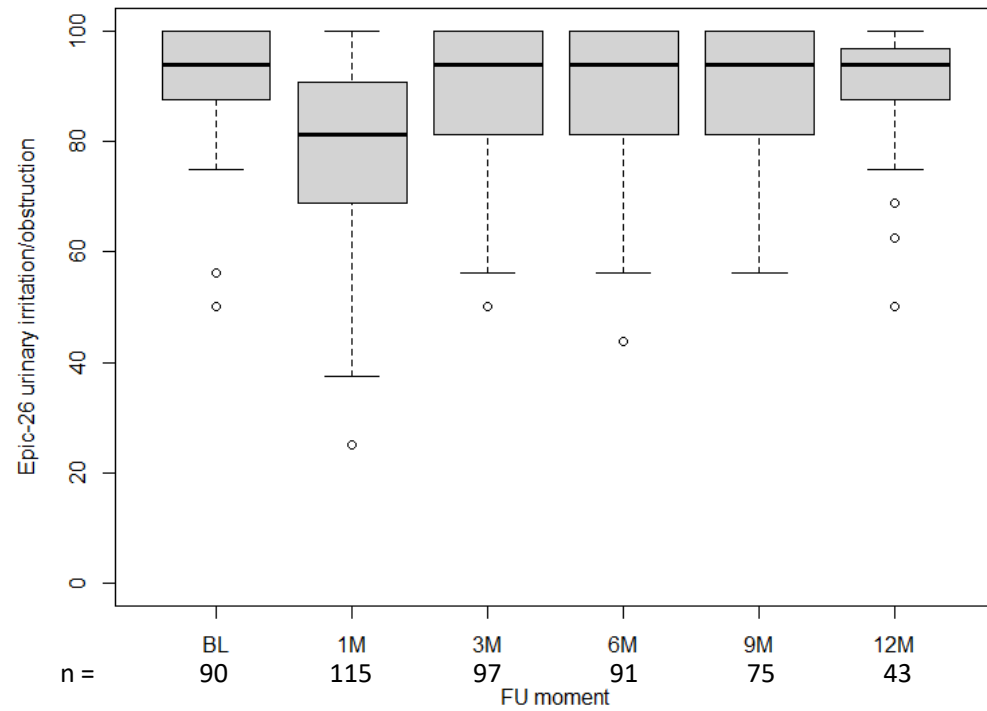


PSA after MR-Linac

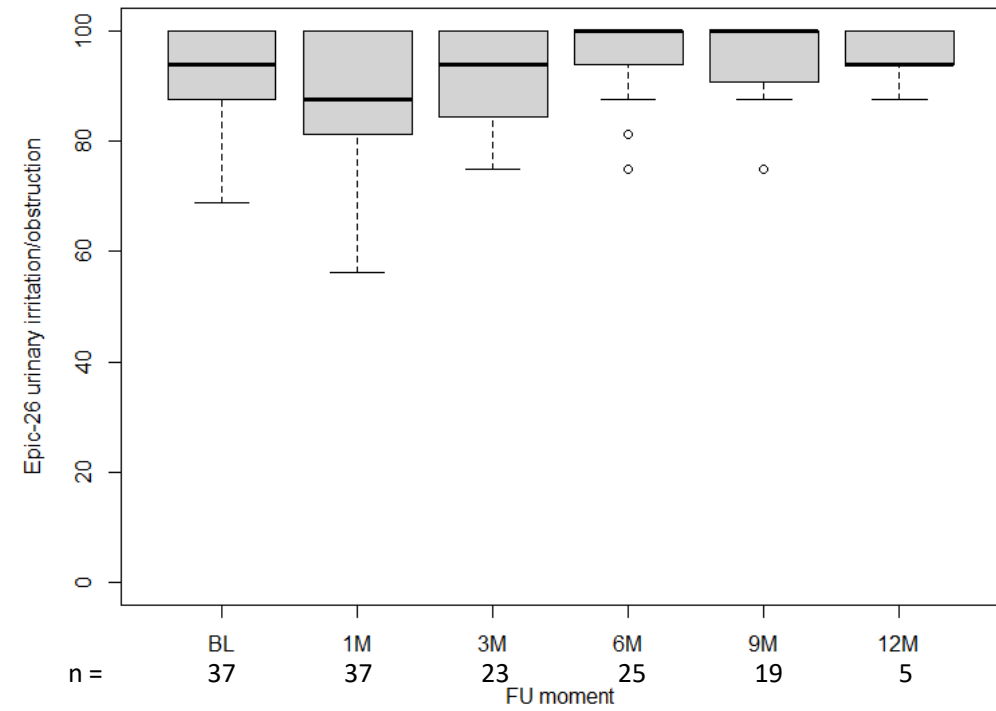


EPIC-26 Urinary obstruction/irritation

MRL

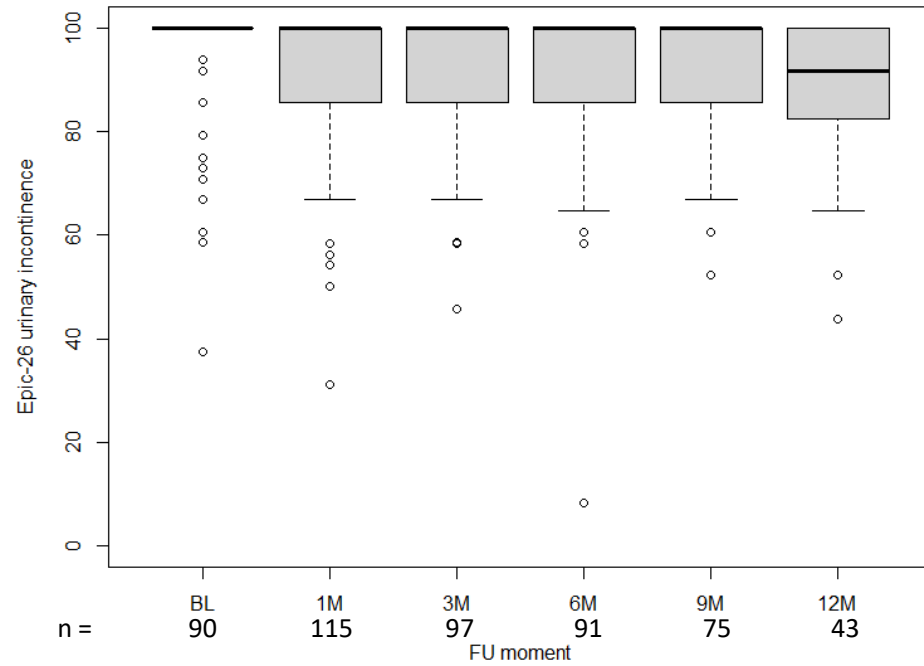


RALP

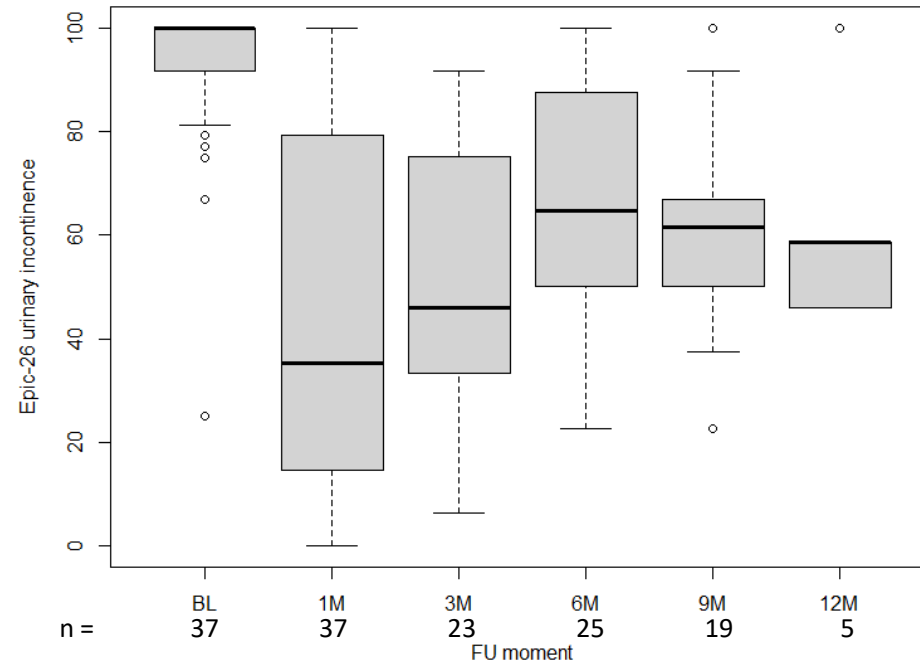


EPIC-26 urinary incontinence

MRL

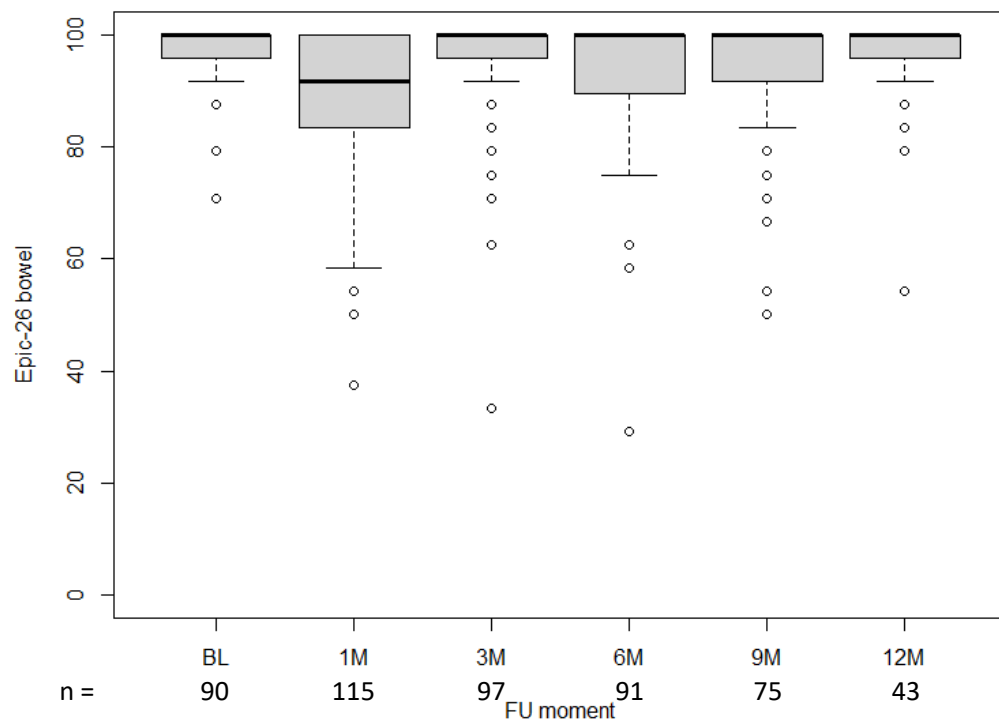


RALP

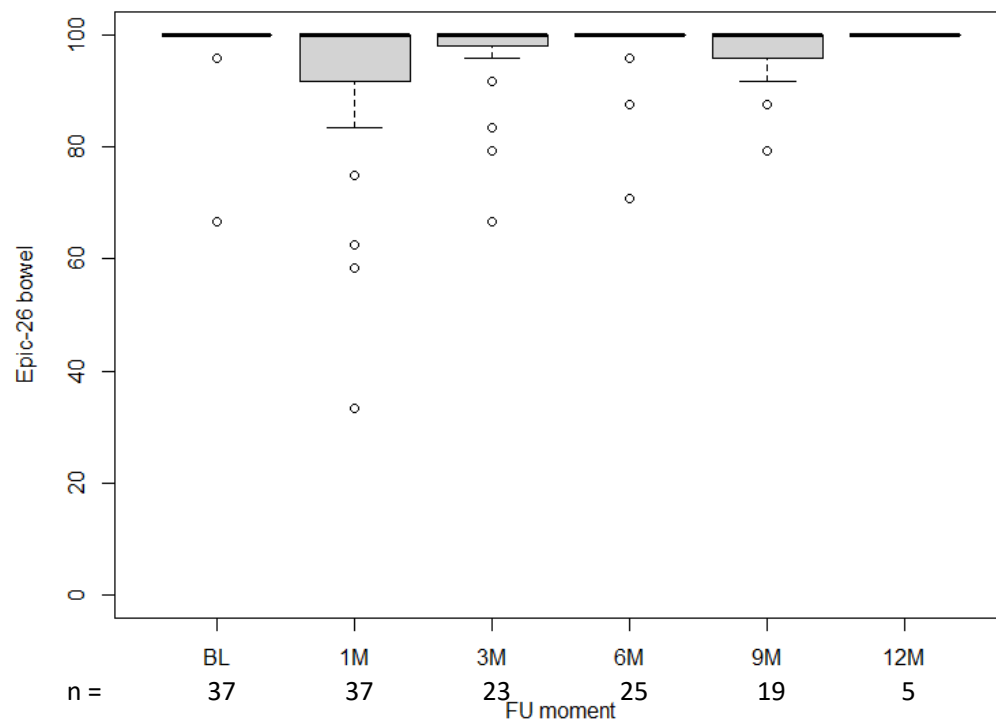


EPIC-26 bowel domain

MRL

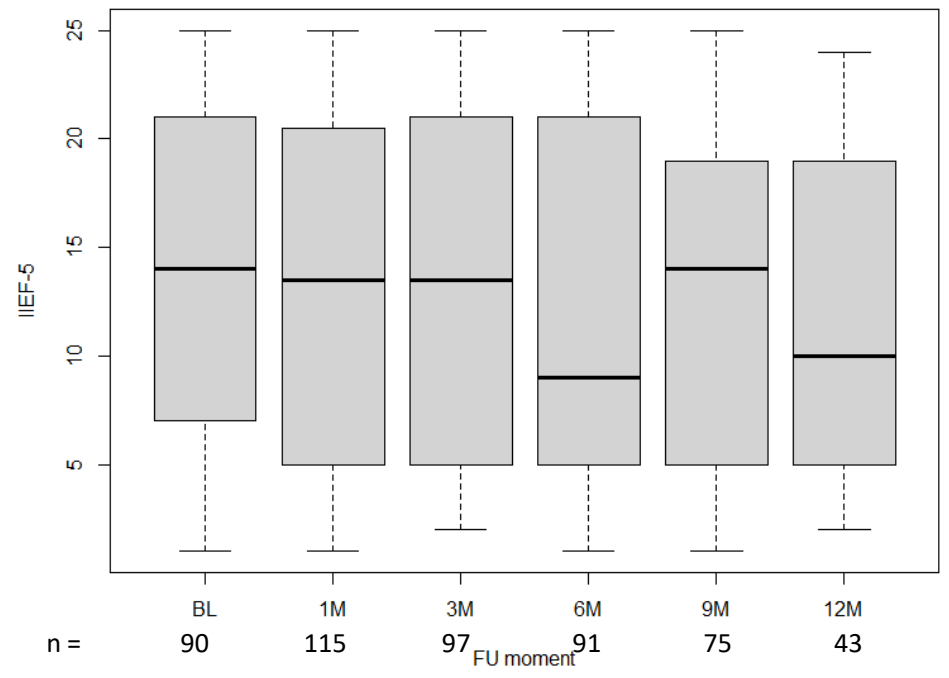


RALP

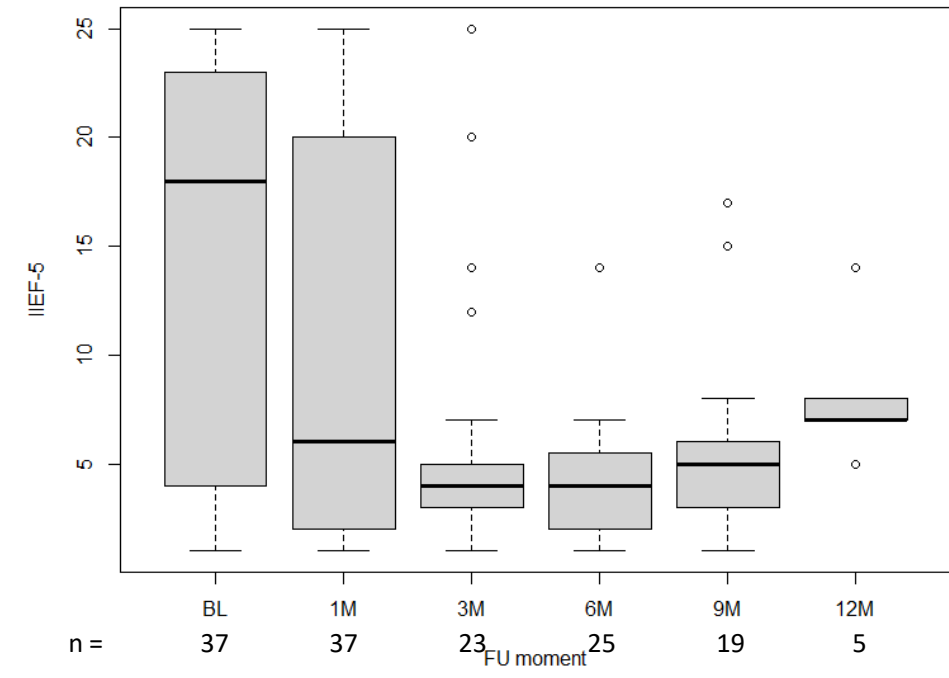


IIEF-5 (erectile function)

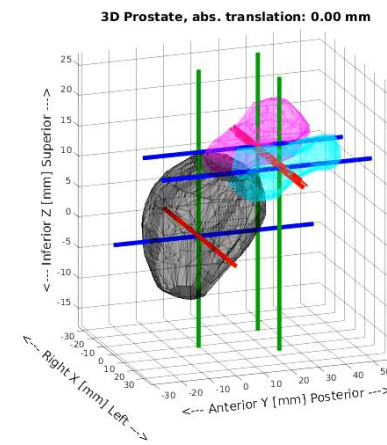
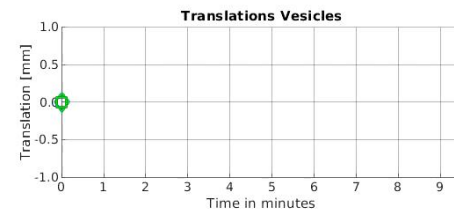
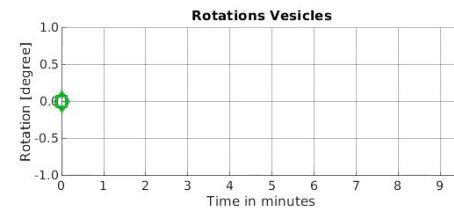
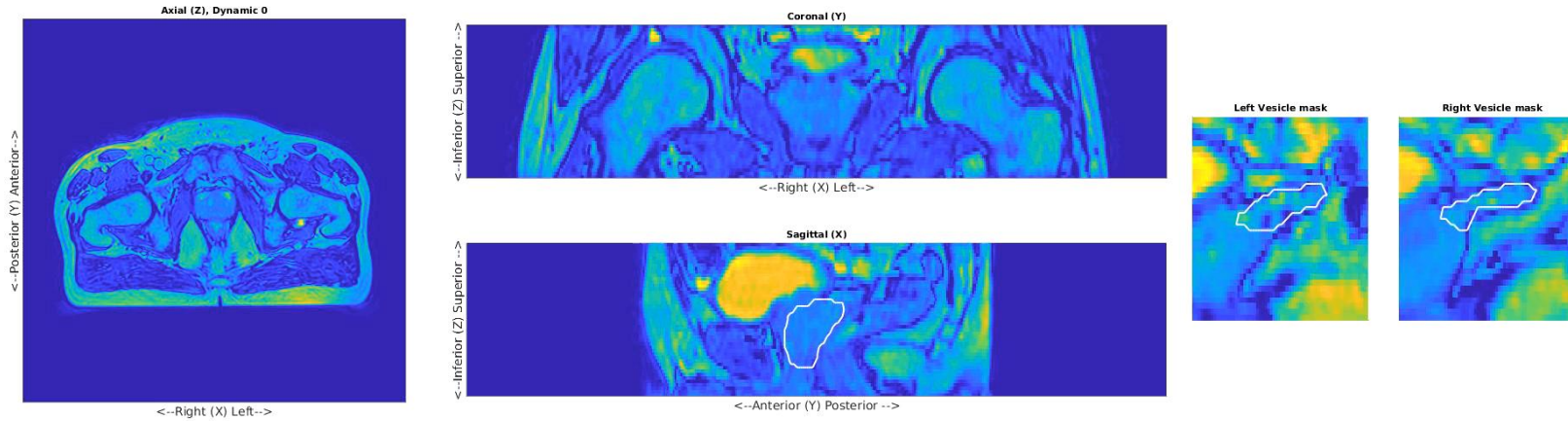
MRL



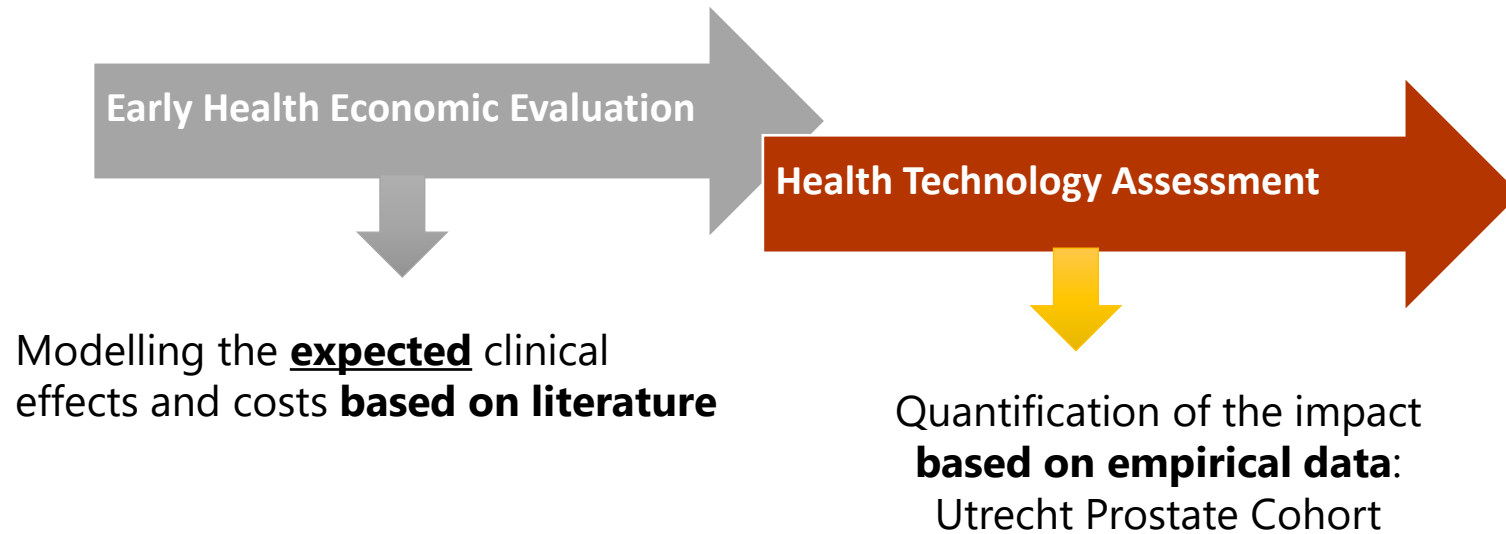
RALP



Technical developments



Evaluation of cost effectiveness on the MR-Linac

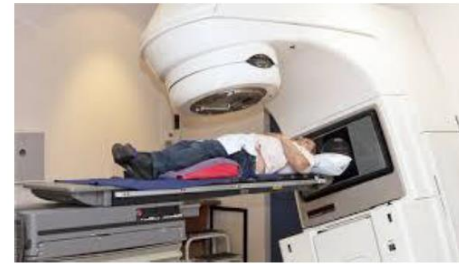


Comparison of ...

5 fractions MR-Linac

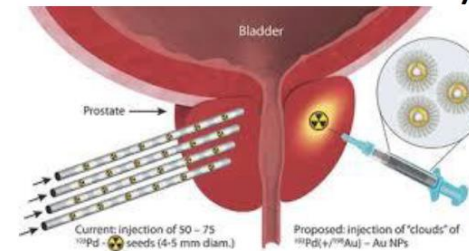


5, 20 and 39 fractions



versus

Low-dose-rate brachytherapy



Average (mean) costs per patient

	Mean costs per patient (Euros)
MR-Linac 5 Fx	10,609
LDR Brachytherapy	9,945
EBRT 5 Fx	8,188
EBRT 20 Fx	15,003
EBRT 39 Fx	21,784

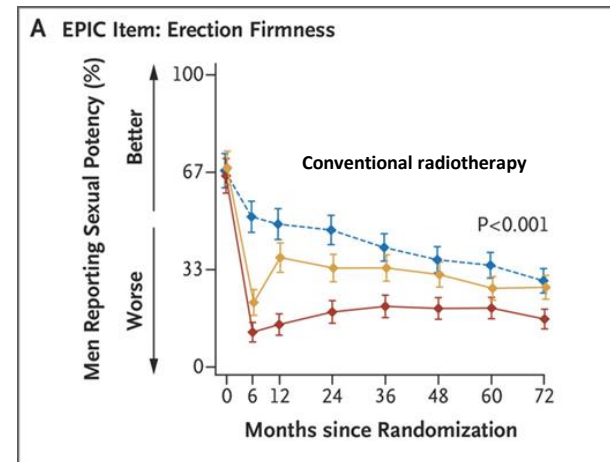
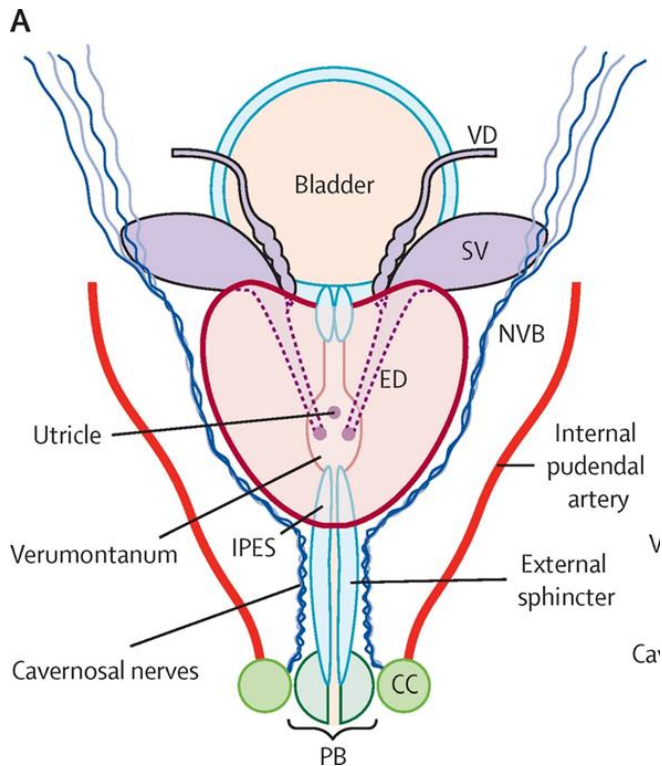
MR-Linac plans for the future

- Neurovasculair sparing radiotherapy for prostate cancer
 - ERECT-trial
- Focal salvage MR-Linac treatment for recurrent disease
 - MRI-SABRE
- 2 fractions on the MR-Linac
 - Hermes-trial (fast-adaptive contouring/planning)
- High risk patients 5x7.25 Gy (boost on DIL), randomized study
 - hypo-FLAME 3.0 study

The ROYAL MARSDEN
NHS Foundation Trust

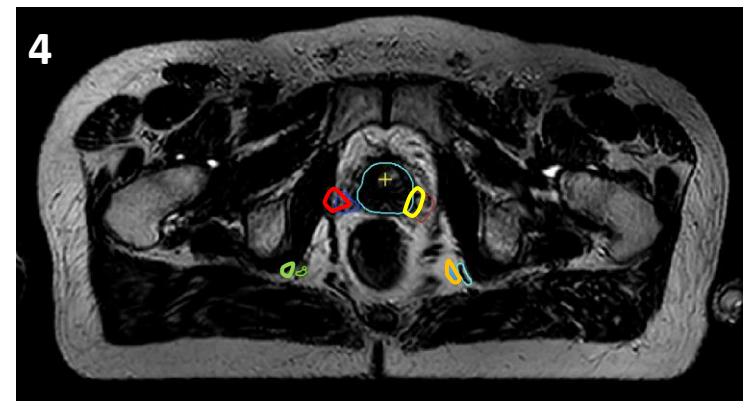
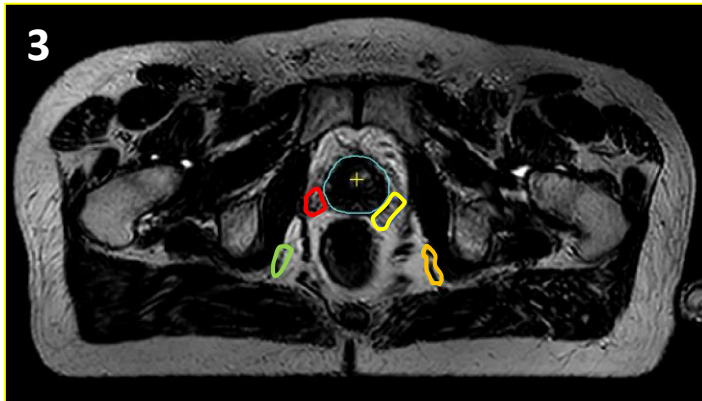
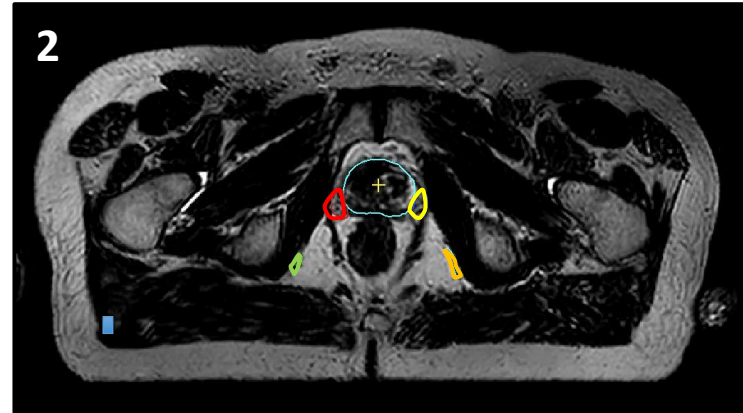
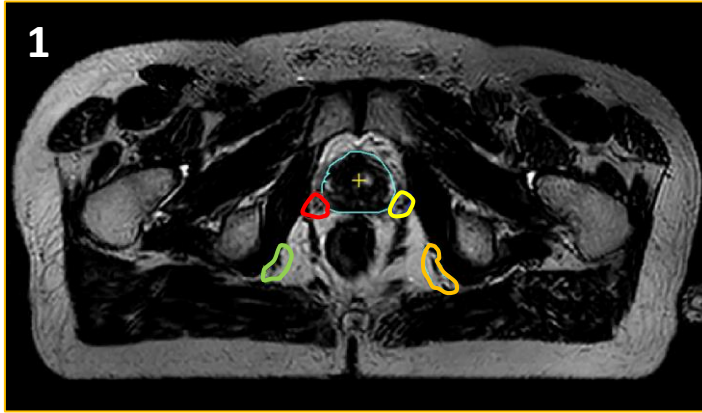
ERectile function preservation for prostate Cancer radiation Therapy (ERECT-trial)

- Study protocol -> IRB approved
- MR-> beter visualization soft tissue





Donovan NEJM 2016

Delineation study: variability and reproducibility



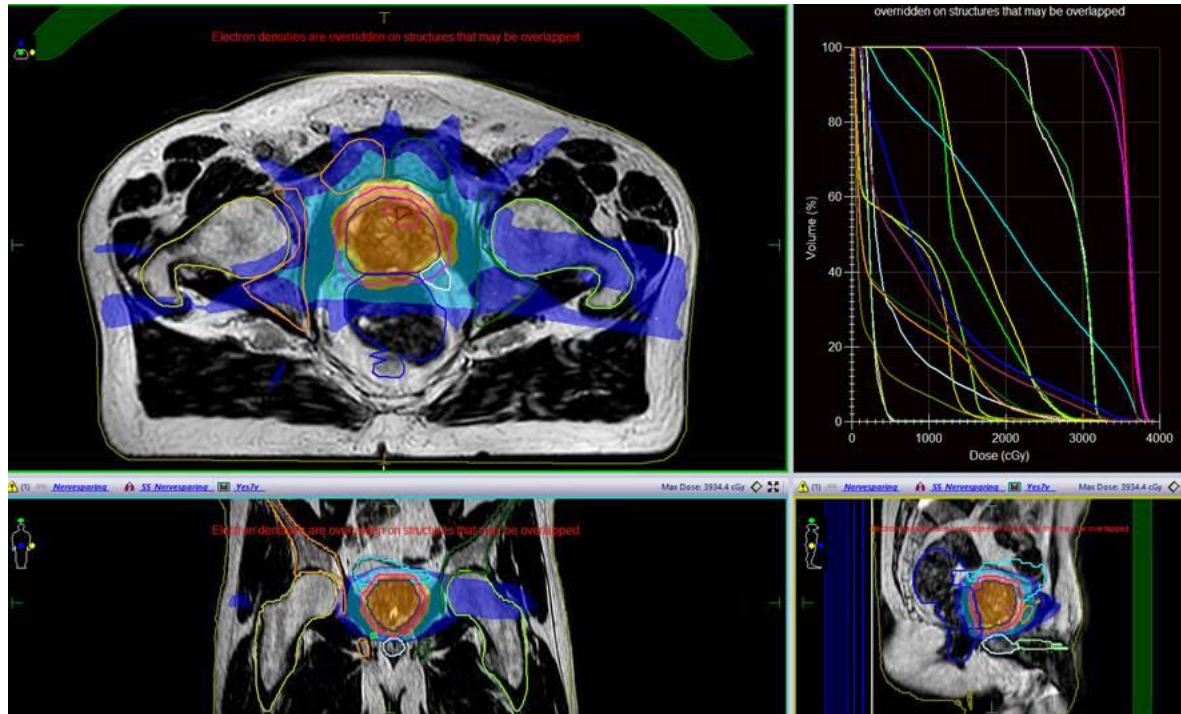
 right neurovascular bundle

 left neurovascular bundle

 right arteria pudenda

 left arteria pudenda

Planning studie: feasibility?



Constraints

Prescribed dose PTV: 36.25 Gy ($\geq 80\%$)
(no concession on GTV)
Minimal dose PTV: 30 Gy

NVB (soft constraint): $D_{0.1cc} \leq 32.75$ Gy
IPA: $D_{max} \leq 20$ Gy

MR-Linac for prostate cancer

- MR-Linac for prostate cancer: better visualisation
 - Reduce uncertainty margins → < toxicity
 - Viewer treatment fractions (comfort/cost effective)
 - Reduce recurrence of prostate cancer
 - Change treatment approach in the next 10-15 years

