



SBRT PRÓSTATA

Da Simulação ao Planejamento



Dosimetrista Ana Carolina de Oliveira

Hospital Mãe de Deus

Porto Alegre - RS

SBRT - Stereotactic Body Radiation Therapy



- Vantagens Radiobiológicas
- Conveniência ao Paciente
- Benefícios aos Centros Radioterápicos
- Benefícios para o Sistema Público de Saúde

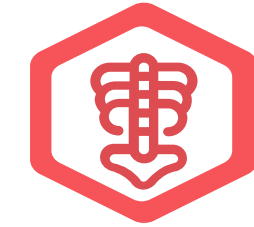
Convencional	Hipofracionamento Moderado	SBRT ("Ultra-Hipofracionado")
70-81 Gy	60-70 Gy	36-40 Gy
35-45 frações	19-28 frações	5 frações
7-9 semanas	4-5.5 semanas	1.5-2 semanas

FLUXOGRAMA HMD



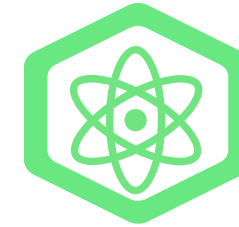
INDICAÇÃO

NUTRICIONISTA



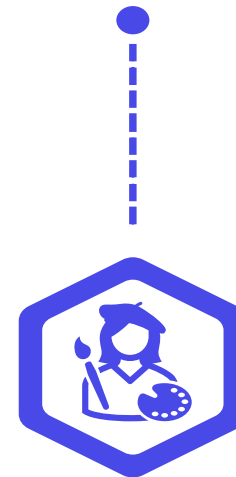
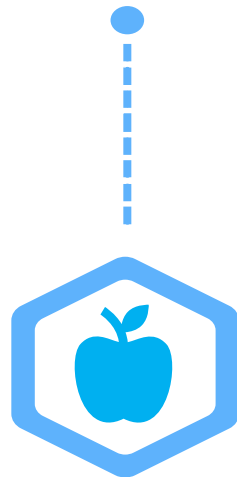
SIMULAÇÃO

DELINEAMENTO



PLANEJAMENTO

TRATAMENTO



INDICAÇÃO

PROTOCOLOS CLÍNICOS

HYPO-RT-PC trial:

- 1.200 pacientes randomizados para 78Gy/39fr vs. 42,7Gy/7fr
- 589 pacientes tratados com SBRT
- SBRT → Pequeno aumento de toxicidade urinaria aguda no 1 ano
Nenhuma diferença de toxicidade gastro intestinal tardia.

A sobrevida livre de falhas em 5 anos foi o mesmo **(84%)**

PACE-B trial:

- 874 pacientes : 78Gy/39fr ou 62Gy/20fr vs. 36,25Gy/5fr
- 433 pacientes tratados com SBRT
- SBRT → Nenhuma diferença significativa na toxicidade.

Ultra-hypofractionated versus conventionally fractionated radiotherapy for prostate cancer: 5-year outcomes of the HYPO-RT-PC randomised, non-inferiority, phase 3 trial

Anders Widmark, Adalsteinn Gunnlaugsson, Lars Beckman, Camilla Thellenberg-Karlsson, Morten Hoyer, Magnus Lagerlund, Jan Kindblom, Claes Glimm, Bengt Johansson, Kirsten Björmlinger, Mihajl Seke, Måns Agrup, Per Fransson, Björn Tavelin, David Norman, Björn Zackrisson, Harald Anderson, Elisabeth Kjellén, Lars Franzén, Per Nilsson

Summary

Background Hypofractionated radiotherapy for prostate cancer has gained increased attention due to its proposed high radiation-fraction sensitivity. Recent reports from studies comparing moderately hypofractionated and conventionally fractionated radiotherapy support the clinical use of moderate hypofractionation. To date, there are no published randomised studies on ultra-hypofractionated radiotherapy. Here, we report the outcomes of the Scandinavian HYPO-RT-PC phase 3 trial with the aim to show non-inferiority of ultra-hypofractionation compared with conventional fractionation.

Methods In this open-label, randomised, phase 3 non-inferiority trial done in 12 centres in Sweden and Denmark, we recruited men up to 75 years of age with intermediate-to-high-risk prostate cancer and a WHO performance status between 0 and 2. Patients were randomly assigned to ultra-hypofractionation (42.7 Gy in seven fractions, 3 days per week for 2.5 weeks) or conventional fractionated radiotherapy (78.0 Gy in 39 fractions, 5 days per week for 8 weeks). No androgen deprivation therapy was allowed. The primary endpoint was time to biochemical or clinical failure, analysed in the per-protocol population. The prespecified non-inferiority margin was 4% at 5 years, corresponding to a critical hazard ratio (HR) limit of 1.338. Physician-recorded toxicity was measured according to the Radiation Therapy Oncology Group (RTOG) morbidity scale and patient-reported outcome measurements with the Prostate Cancer Symptom Scale (PCSS) questionnaire. This trial is registered with the ISRCTN registry, number ISRCTN45905321.

Findings Between July 1, 2005, and Nov 4, 2015, 1200 patients were randomly assigned to conventional fractionation (n=602) or ultra-hypofractionation (n=598), of whom 1180 (591 conventional fractionation and 589 ultra-hypofractionation) constituted the per-protocol population. 1054 (89%) participants were intermediate risk and 126 (11%) were high risk. Median follow-up time was 5.0 years (IQR 3.1–7.0). The estimated failure-free survival at 5 years was 84% (95% CI 80–87) in both treatment groups, with an adjusted HR of 1.002 (95% CI 0.758–1.325; log-rank p=0.99). There was weak evidence of an increased frequency of acute physician-reported RTOG grade 2 or worse urinary toxicity in the ultra-hypofractionation group at end of radiotherapy (158 [28%] of 569 patients vs 132 [23%] of 578 patients; p=0.057). There

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See Online/Comment
[http://dx.doi.org/10.1016/S0140-6736\(19\)31141-3](http://dx.doi.org/10.1016/S0140-6736(19)31141-3)
Department of Radiation Sciences, Oncology (Prof A Widmark MD, C Thellenberg-Karlsson MD, B Tavelin BSc, D Norman BSc, Prof B Zackrisson MD, Prof L Franzén MD) and Department of Nursing (P Fransson PhD), Umeå University, Umeå, Sweden; Department of Hematology, Oncology and Radiation Physics, Skåne University Hospital (A Gunnlaugsson MD, E Kjellén MD, Per Nilsson PhD) and Department of Clinical Sciences Lund, Cancer Epidemiology (H Anderson PhD), Lund University, Lund, Sweden; Department of Oncology, Karolinska University Hospital, Stockholm, Sweden

Intensity-modulated fractionated radiotherapy versus stereotactic body radiotherapy for prostate cancer (PACE-B): acute toxicity findings from an international, randomised, open-label, phase 3, non-inferiority trial

Douglas H Brand*, Alison C Tree*, Peter Ostler, Hans van der Voet, Andrew Loblaw, William Chu, Daniel Ford, Shaun Tolan, Suneil Jain, Alexander Martin, John Staffurth, Philip Camilleri, Kiran Kancherla, John Frew, Andrew Chan, Ian S Dayes, Daniel Henderson, Stephanie Brown, Clare Cruickshank, Stephanie Burnett, Aileen Duffton, Clare Griffin, Victoria Hinder, Kirsty Morrison, Olivia Naismith, Emma Hall, Nicholas van As, on behalf of the PACE Trial Investigators

Summary

Background Localised prostate cancer is commonly treated with external-beam radiotherapy. Moderate hypofractionation has been shown to be non-inferior to conventional fractionation. Ultra-hypofractionated stereotactic body radiotherapy would allow shorter treatment courses but could increase acute toxicity compared with conventionally fractionated or moderately hypofractionated radiotherapy. We report the acute toxicity findings from a randomised trial of standard-of-care conventionally fractionated or moderately hypofractionated radiotherapy versus five-fraction stereotactic body radiotherapy for low-risk to intermediate-risk localised prostate cancer.

Methods PACE is an international, phase 3, open-label, randomised, non-inferiority trial. In PACE-B, eligible men aged 18 years and older, with WHO performance status 0–2, low-risk or intermediate-risk prostate adenocarcinoma (Gleason 4+3 excluded), and scheduled to receive radiotherapy were recruited from 37 centres in three countries (UK, Ireland, and Canada). Participants were randomly allocated (1:1) by computerised central randomisation with permuted blocks (size four and six), stratified by centre and risk group, to conventionally fractionated or moderately hypofractionated radiotherapy (78 Gy in 39 fractions over 7.8 weeks or 62 Gy in 20 fractions over 4 weeks, respectively) or stereotactic body radiotherapy (36.25 Gy in five fractions over 1–2 weeks). Neither participants nor investigators were masked to allocation. Androgen deprivation was not permitted. The primary endpoint of PACE-B is freedom from biochemical or clinical failure. The coprimary outcomes for this acute toxicity substudy were worst grade 2 or more severe Radiation Therapy Oncology Group

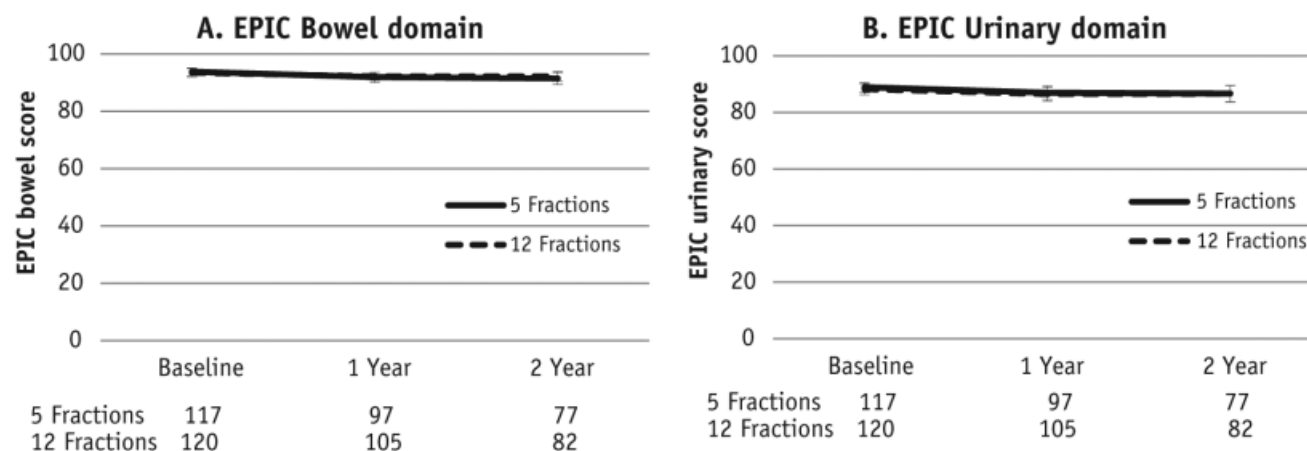


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See Comment page 1471
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The Royal Marsden Hospital, London, UK (D H Brand MRes, A C Tree MD[Res]), Mount Vernon Cancer Centre, Northwood, UK (P Ostler FRCR); The James Cook University Hospital, Middlesbrough, UK (H van der Voet MD); Odette Cancer Centre, Sunnybrook



RTOG 0938:

- 127 pacientes $5 \times 7.25 \text{ Gy} = 36.25 \text{ Gy}$
VS.
128 pacientes $12 \times 4.3 \text{ Gy} = 51.60 \text{ Gy}$
 - Nenhuma diferença significativa na toxicidade.
- Sobrevida livre de falhas em 2 anos foi o mesmo



NRG ONCOLOGY
RTOG 0938

**A RANDOMIZED PHASE II TRIAL OF HYPOFRACTIONATED RADIOTHERAPY
FOR FAVORABLE RISK PROSTATE CANCER**

Study Chairs (12/15/15)

Principal Investigator/Radiation Oncology Himu Lukka, MD McMaster University/Juravinski Cancer Centre 699 Concession Street Hamilton, Ontario Canada L6J4W5 Phone: 905-387-9495 ext.64702/ Fax: 905-575-6326 E-mail: Himu.Lukka@hhsc.ca	Radiation Oncology Jean-Paul Bahary, MD Centre Hospitalier de L'Université de Montreal (CHUM) Notre-Dame Hospital – Pavillon Lachapelle (Porte: TS-3340) 1560, rue Sherbrooke Est Montreal, Quebec H2L 4M1 Phone: 514-890-8254/Fax: 514-412-7537 E-mail: jean-paul.bahary.chum@ssss.gouv.qc.ca
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Published in final edited form as:
Int J Radiat Oncol Biol Phys. 2018 October 01; 102(2): 287–295. doi:10.1016/j.ijrobp.2018.06.008.

**Patient Reported Outcomes in NRG Oncology RTOG 0938,
Evaluating Two Ultrahypofractionated Regimens for Prostate
Cancer**



INDICAÇÃO

CRITÉRIOS HMD

ELEGÍVEIS

- ✓ Baixo Risco
- ✓ Intermediário favorável
- ✓ Re-Irradiações

DISCUTÍVEIS

- x Alto Risco *
- x Próteses **
- x Pacientes com incontinência urinária



INDICAÇÃO

CRITÉRIOS HMD

ELEGÍVEIS

- ✓ Baixo Risco
- ✓ Intermediário favorável
- ✓ Re-Irradiações

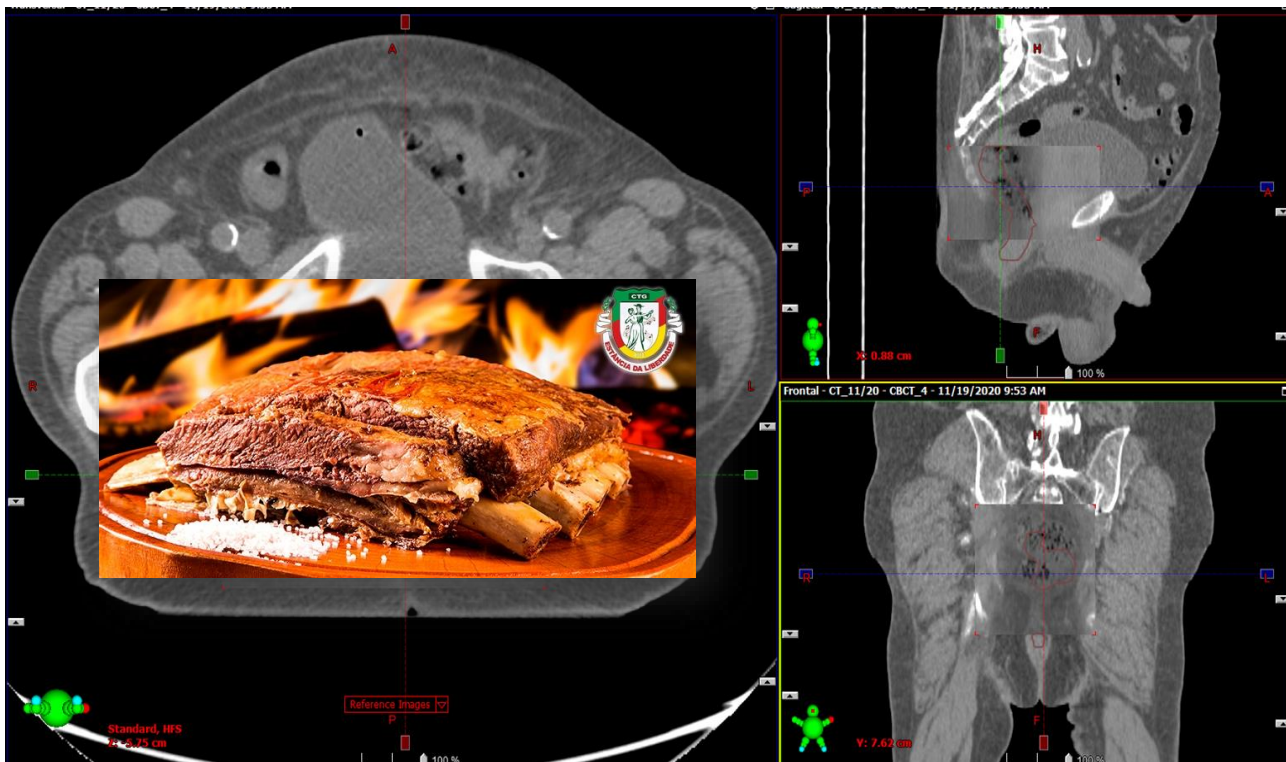
DISCUTÍVEIS

- x Alto Risco *
- x Próteses **
- x Pacientes com incontinência urinária

NUTRICIONISTA

CONSULTA PRÉ SIMULAÇÃO

- Conhecer o Paciente
- Protocolo nutricional
- Orientações para a tomografia



PREPARO PARA TOMOGRAFIA DE PELVE - PRÓSTATA

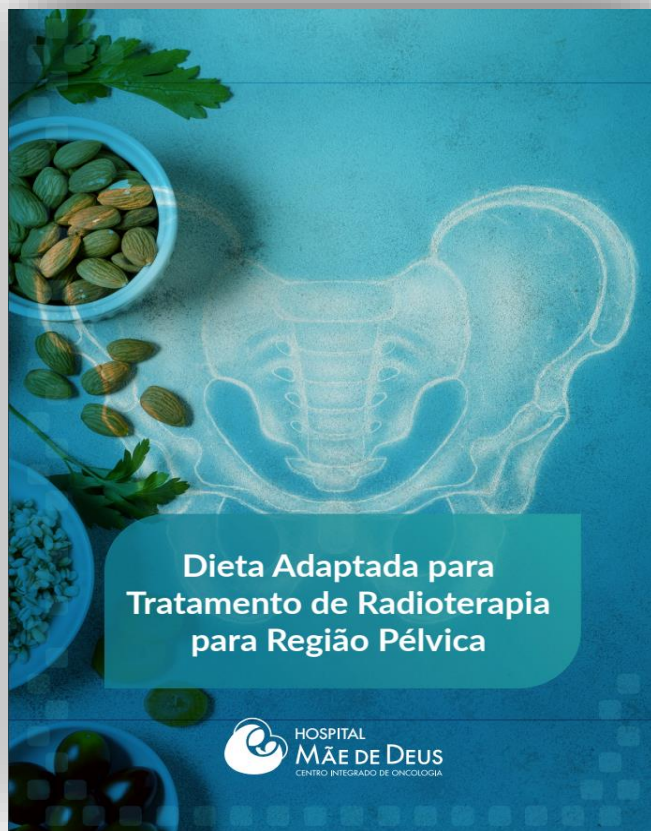
- **DIETA:** Iniciar 48h antes do exame
Data: __/__/__
- **DULCOLAX:** Laxante via oral
Data: __/__/__ - Horário: 7h (2 comprimidos)
Data: __/__/__ - Horário: 7h (2 comprimidos)
Data: __/__/__ - Horário: 19h (2 comprimidos)
- **PHOSFO ENEMA:** Via retal
Data: __/__/__ - Horário: _____
- **LUFTAL:** Gotas via oral
Data: __/__/__ - Horário: 19h (40 gotas)
Data: __/__/__ - Horário: 7h (40 gotas)
- **JEJUM DE 2H**
- **BEXIGA CHEIA:**
Tomar 4 copos de água 30 MINUTOS ANTES do exame



NUTRICIONISTA

DURANTE O TRATAMENTO

- Dieta adaptada
- Consulta na 3 aplicação





CONFORTO E GARANTIA DE REPRODUTIBILIDADE!

- ✓ Aparato mínimo: Apoio de pés ou joelhos*
- ✓ Permitido artifícios mais “complexos”: *Vaclock, Body frame, etc*



- Bexiga: Reprodutível
- Reto: Vazio
- Uretra : Sonda (HMD)

* Para apoio de joelhos é importante a indexação

SIMULAÇÃO

Tomografia de Planejamento

Tomografia “curta”
(Verificação do Preparo)

Inserção da Sonda Uretral

SCOUT



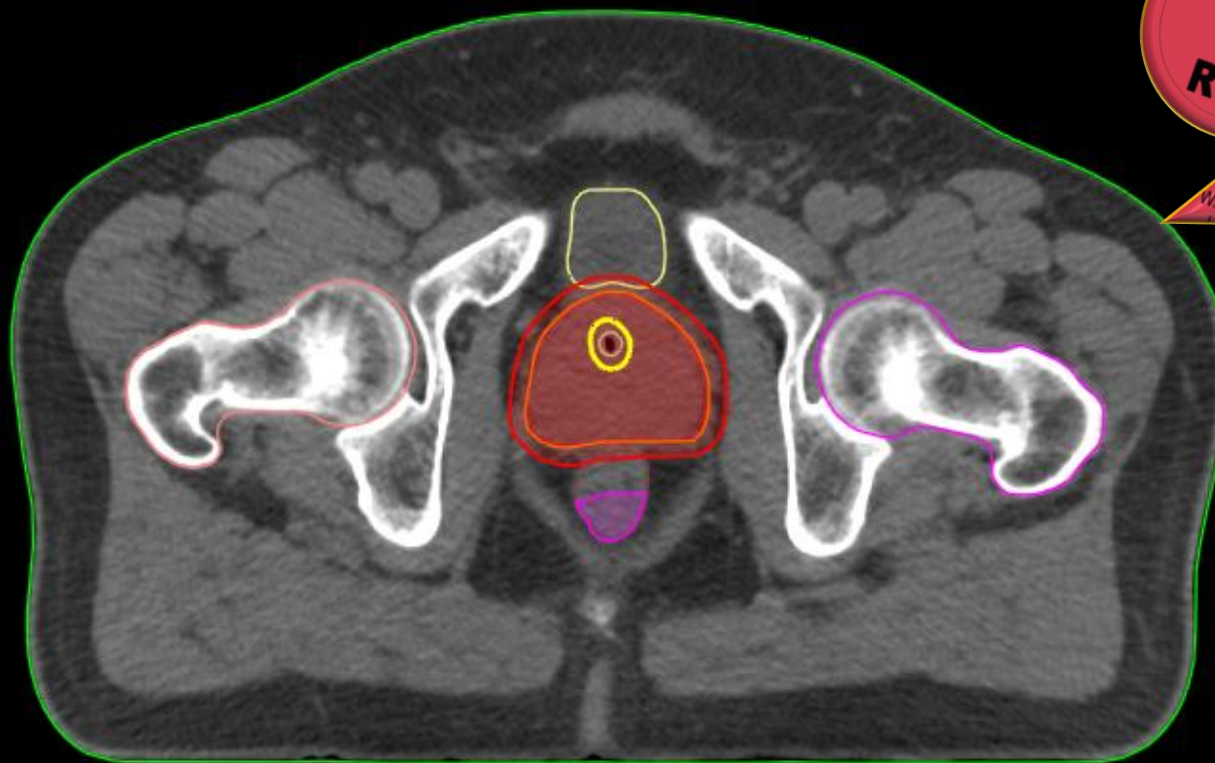
(TG e RTOG)

- Slices <3mm (2.5mm)
- Visualização da Uretra desejável

DELINEAMENTO

ÓRGÃOS DE RISCO

- ☒ **SBRT**
- ☒  _PTVopt
- ☒  _RectalWall
- ☒  Bladder
- ☒  Body
- ☒  CTV
- ☒  Femur_L
- ☒  Femur_R
- ☒  Prostate
- ☒  PTV_3625cGy
- ☒  Rectum
- ☒  SeminalVesicle
- ☒  Urethra
- ☒  UrethraPRV03
- ☐  User Origin



OARs:

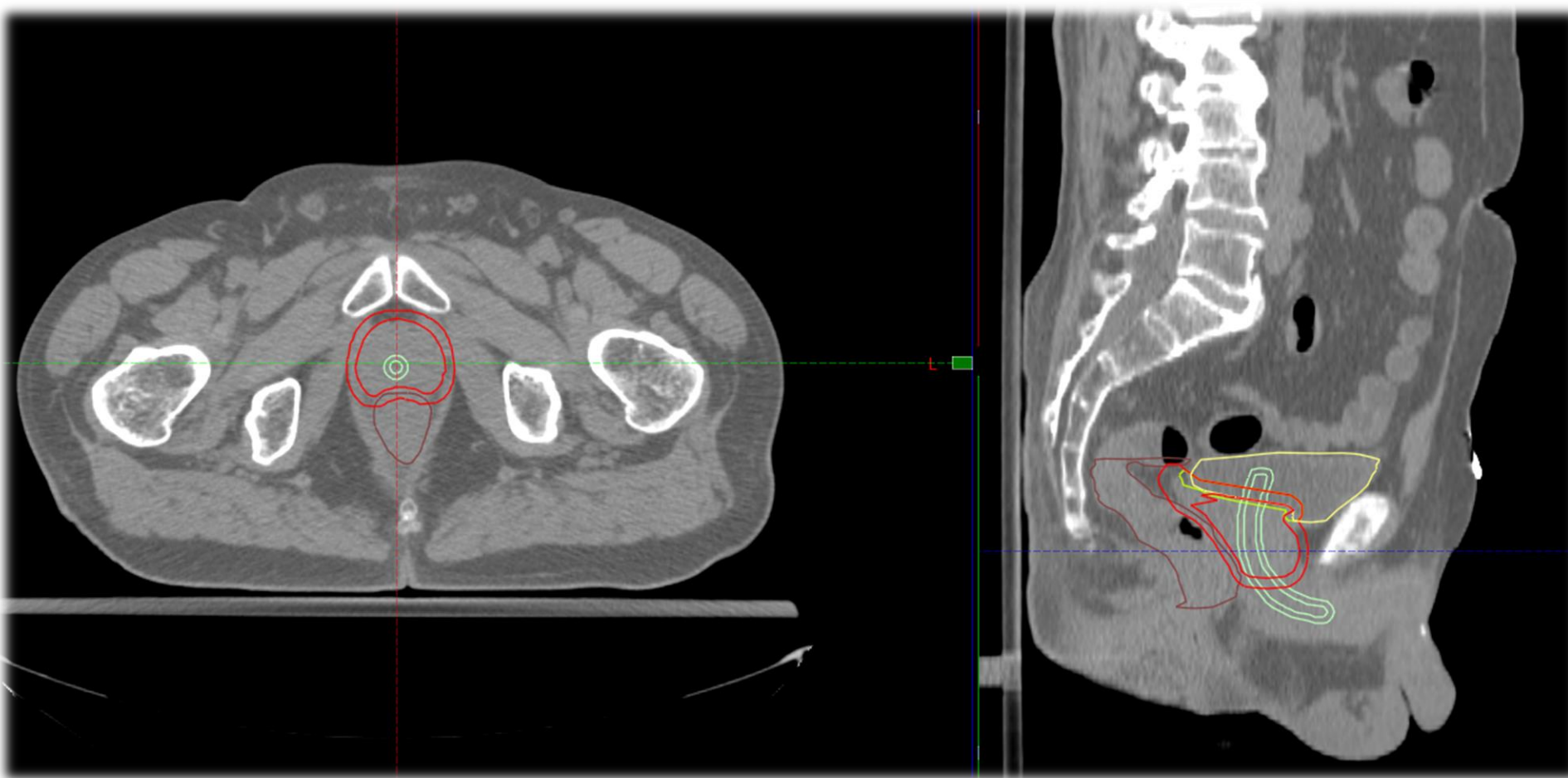
Reprodução Reto, Bexiga

URETRA*



DELINEAMENTO

ÓRGÃOS DE RISCO



Na falta de Sonda

- ✓ Ponto virtual *
- ✓ PRV 03 cm
- ✓ Nada

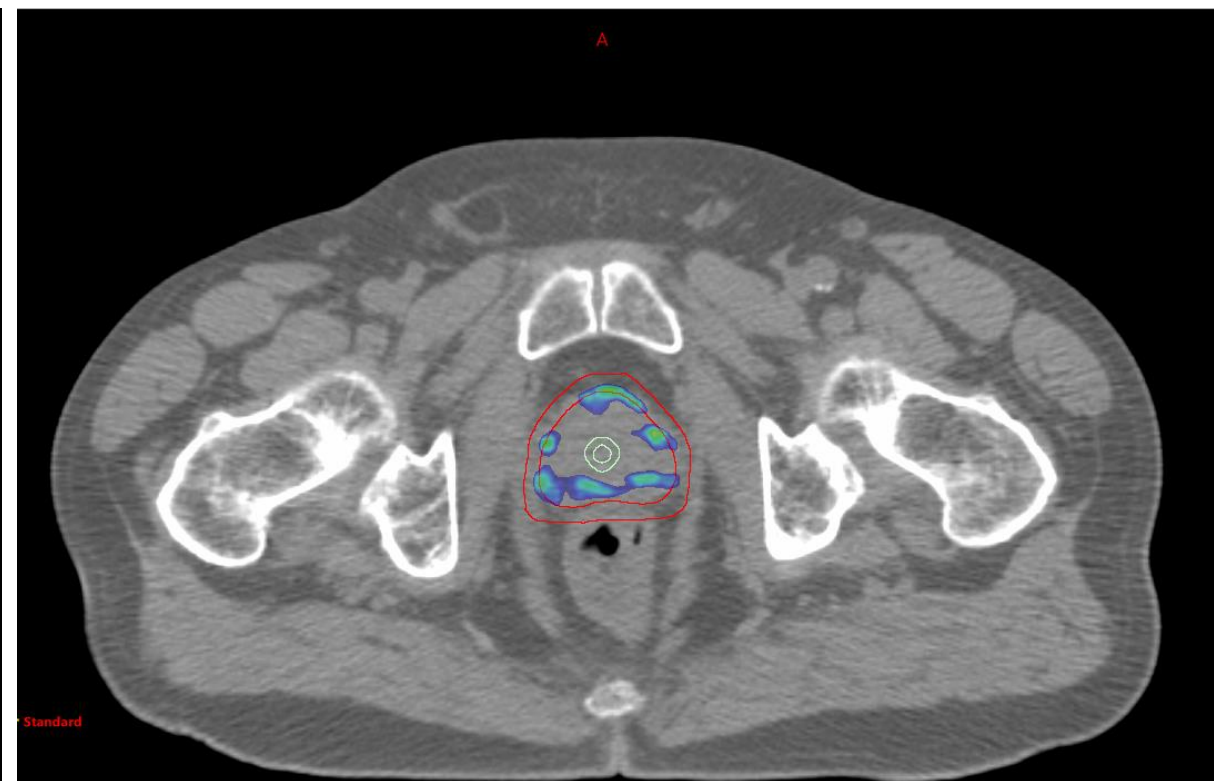
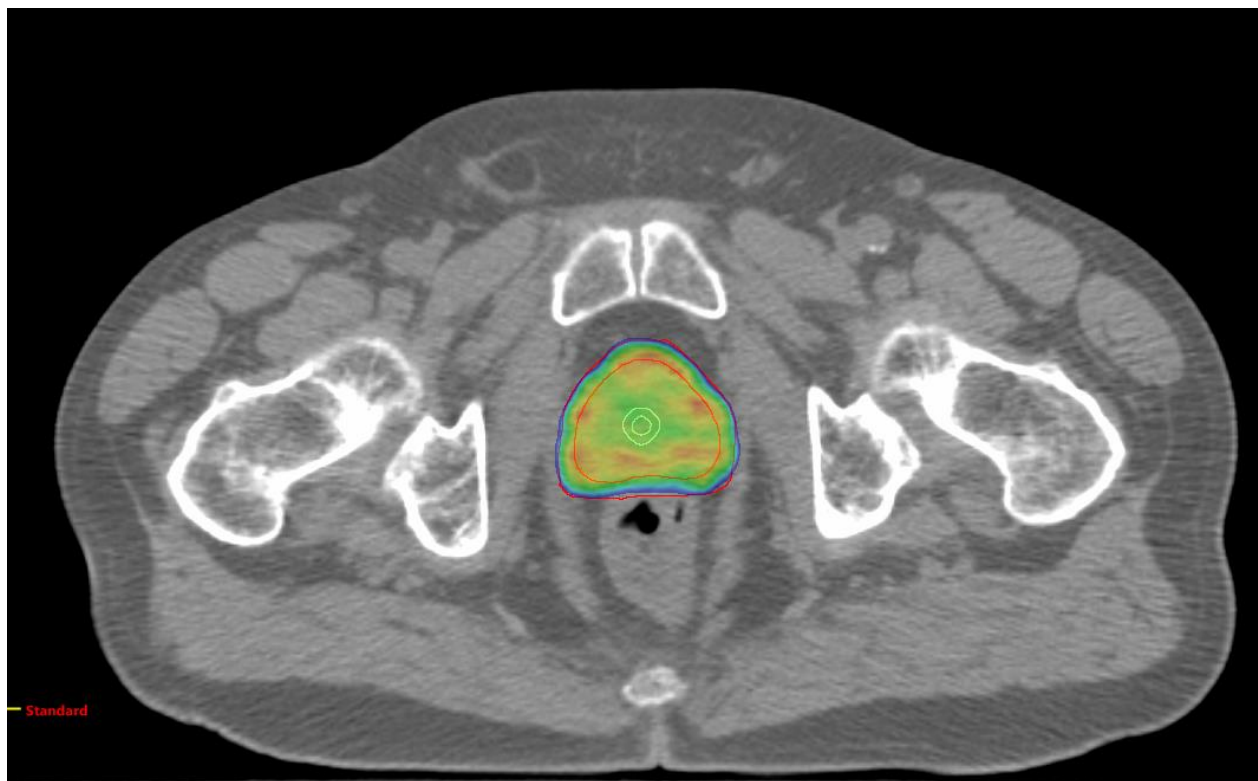
6.9.3

Acceptable dose heterogeneity will be as follows: **This maximum dose volume of the PTV must not be shared by a normal critical structure (Section 6.6.1.6). The urethra dose should not exceed 107% of the prescription dose.** In addition, the dose to the prostate rectal interface and prostate bladder interface should not exceed the dose constraint parameters highlighted in Section 6.6.1.6. The treating physician must carefully consider the tolerance dose/volume to each critical normal structure and unspecified tissue. **RTOG 0938**



95% da dose

105% da dose



Na falta de sonda = evitar pontos quentes na região central da Próstata



PLANEJAMENTO

COMO PLANEJAR ESSE PACIENTE?

- Energia: 6MV, 10MV, **FFF** se disponível
- MLC:
- Grid:
- Uso de estruturas

JOURNAL OF APPLIED CLINICAL MEDICAL PHYSICS, VOLUME 16, NUMBER 6, 2015

Comparison of VMAT-SABR treatment plans with flattening filter (FF) and flattening filter-free (FFF) beam for localized prostate cancer

Jin-Beom Chung,^{1a} Jae-Sung Kim,¹ Keun-Yong Eom,¹ In-Ah Kim,¹
Sang-Won Kang,² Jeong-Woo Lee,³ Jin-Young Kim,⁴ Tae-Suk Suh²

Resultados similares para 6MV FF, 10MV FF e 6MV FFF e 10MV FFF

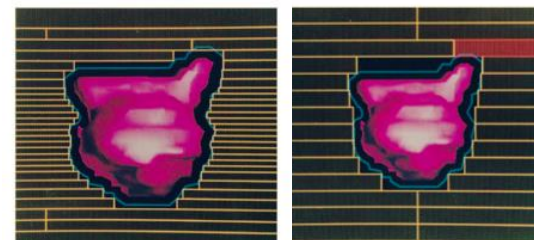
The dosimetric effects of photon energy on the quality of prostate volumetric modulated arc therapy

Malcolm D. Mattes MD*, Cyril Tai CMD, Alvin Lee BS,
Hani Ashamalla MD, N.C. Ikoro PhD

Department of Radiation Oncology, New York Methodist Hospital, Brooklyn, New York

PLANEJAMENTO

COMO PLANEJAR ESSE PACIENTE?



- Energia: 6MV, 10MV, FFF se disponível
- MLC: Ideal $\leq 5\text{mm}$
- Grid:
- Uso de estruturas

Stereotactic IMRT for prostate cancer: Dosimetric impact of multileaf collimator leaf width in the treatment of prostate cancer with IMRT

[L. Wang](#),¹ [B. Movsas](#),¹ [R. Jacob](#),¹ [E. Fourkal](#),¹ [L. Chen](#),¹ [R. Price](#),¹ [S. Feigenberg](#),¹ [A. Konski](#),¹ [A. Pollack](#),¹ and [C. Ma](#)¹

- 4mm vs. 10mm: Diferença significativa

Effect of MLC leaf width on treatment adaptation and accuracy for concurrent irradiation of prostate and pelvic lymph nodes

Qingyang Shang, Peng Qi, Samah Ferjani, and Ping Xia^{a)}
Department of Radiation Oncology, Cleveland Clinic, Cleveland, Ohio 44195

- Lâmina de 5mm melhor que 10mm

Impact of multileaf collimator width on intraprostatic dose painting plans for dominant intraprostatic lesion of prostate cancer^{*}

[Eisuke Abe](#),¹ [Takashi Mizowaki](#),² [Yoshiki Norihisa](#),² [Yuuichirou Narita](#),² [Yukinori Matsuo](#),² [Masaru Narabayashi](#),² [Yasushi Nagata](#),³ and [Masahiro Hiraoka](#)²

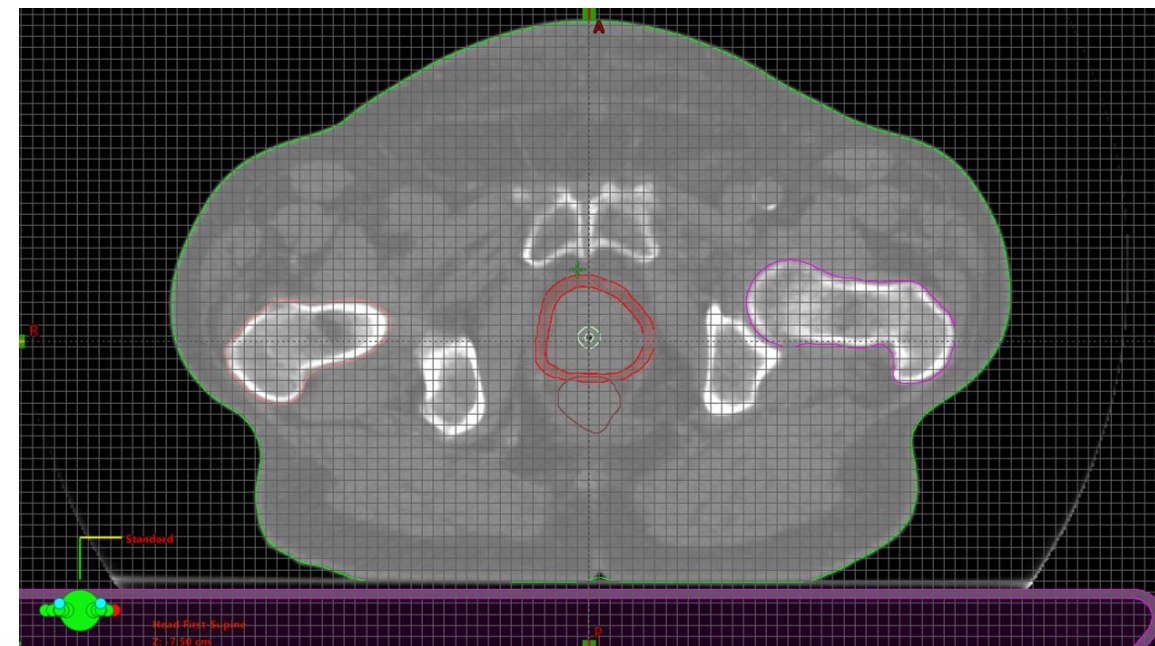
- 3mm vs. 5mm: Diferença pequena



PLANEJAMENTO

COMO PLANEJAR ESSE PACIENTE?

- Energia: 6MV, 10MV, FFF se disponível
- MLC: Ideal $\leq 5\text{mm}$
- Grid: Ideal $\leq 2\text{mm}$, nunca $> 3\text{mm}$
- Uso de estruturas



Stereotactic body radiation therapy: The report of AAPM Task Group 101

Recommendation: SBRT commonly includes extremely high-dose gradients near the boundary of the target and often makes use of IMRT techniques. This report recommends the use of an isotropic grid size of 2 mm or finer. The use of grid sizes greater than 3 mm is discouraged for SBRT.

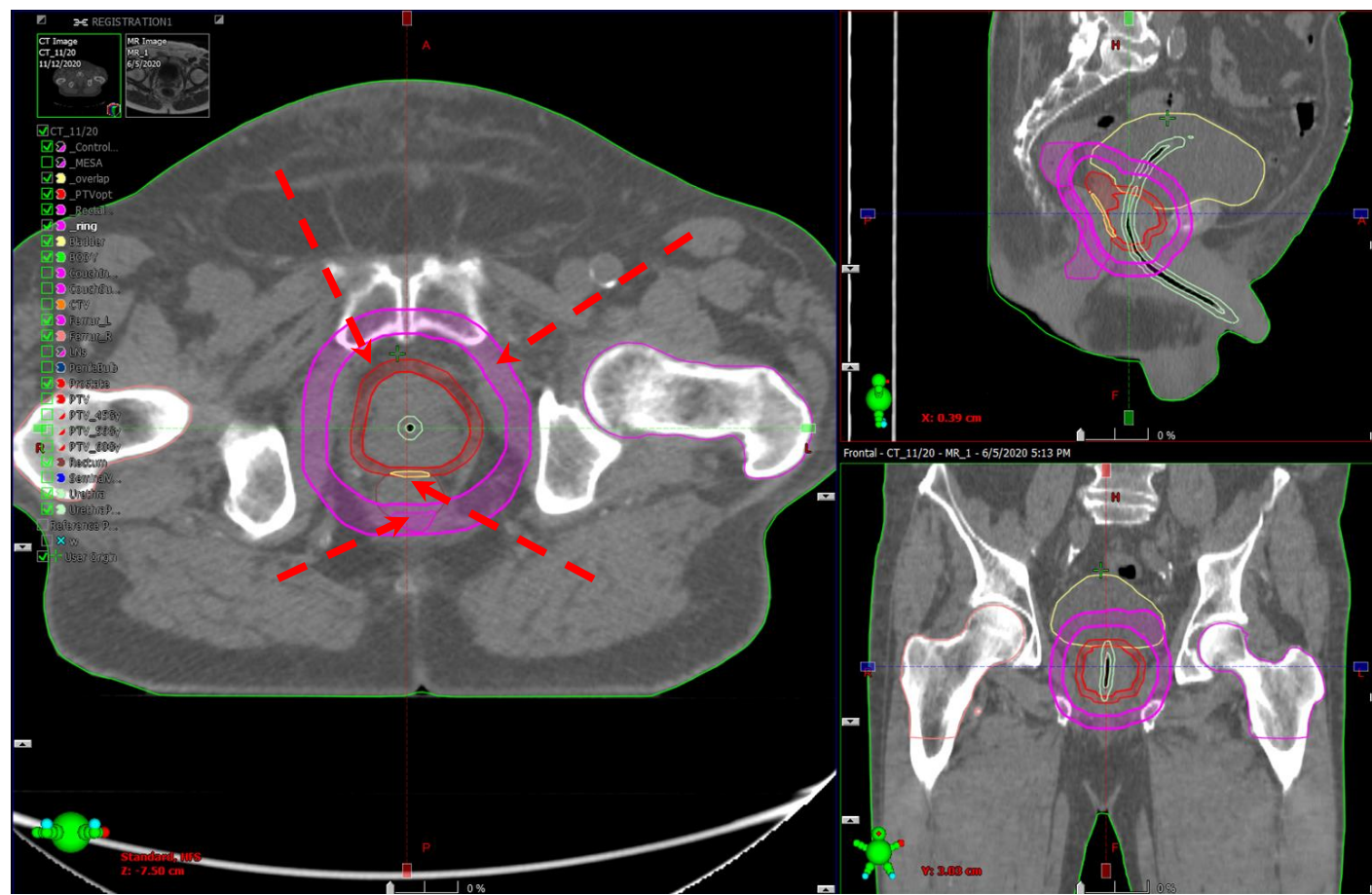
Calculation grid size in CM	0.2
Field normalization type	100% to isocenter
Heterogeneity correction	ON



PLANEJAMENTO

COMO PLANEJAR ESSE PACIENTE?

- Energia: 6MV, 10MV, FFF se disponível
- MLC: Ideal $\leq 5\text{mm}$
- Grid: Ideal $\leq 2\text{mm}$, nunca $> 3\text{mm}$
- Uso de estruturas: Software



Eclipse Versão 13.06

Experiência HMD



PLANEJAMENTO

COMO PLANEJAR ESSE PACIENTE?

- Técnica VMAT: Arco único vs. 2 arcos
- Energia: 6SRS (1000MU/min)

Arco Único col 10:

2662 MUs

~2:40min (beam on)

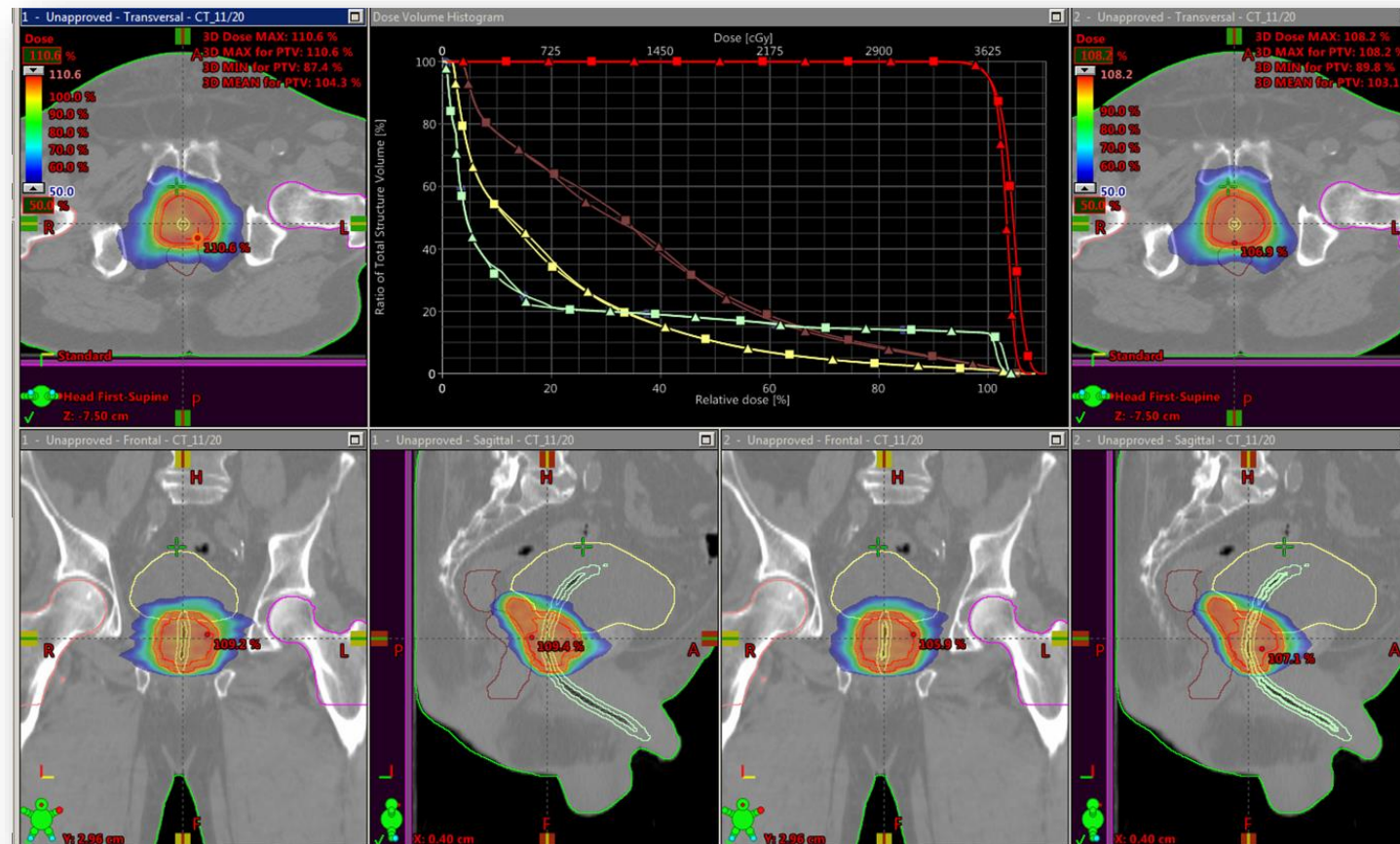
- ✓ Mantém taxa
- ✓ Diminui Vel. Gantry

2 Arcos:

2721 MUs

~2:45min (beam on)

- + Carregar campo
- + Colimador



Dose : 5x725cGy

Experiência HMD



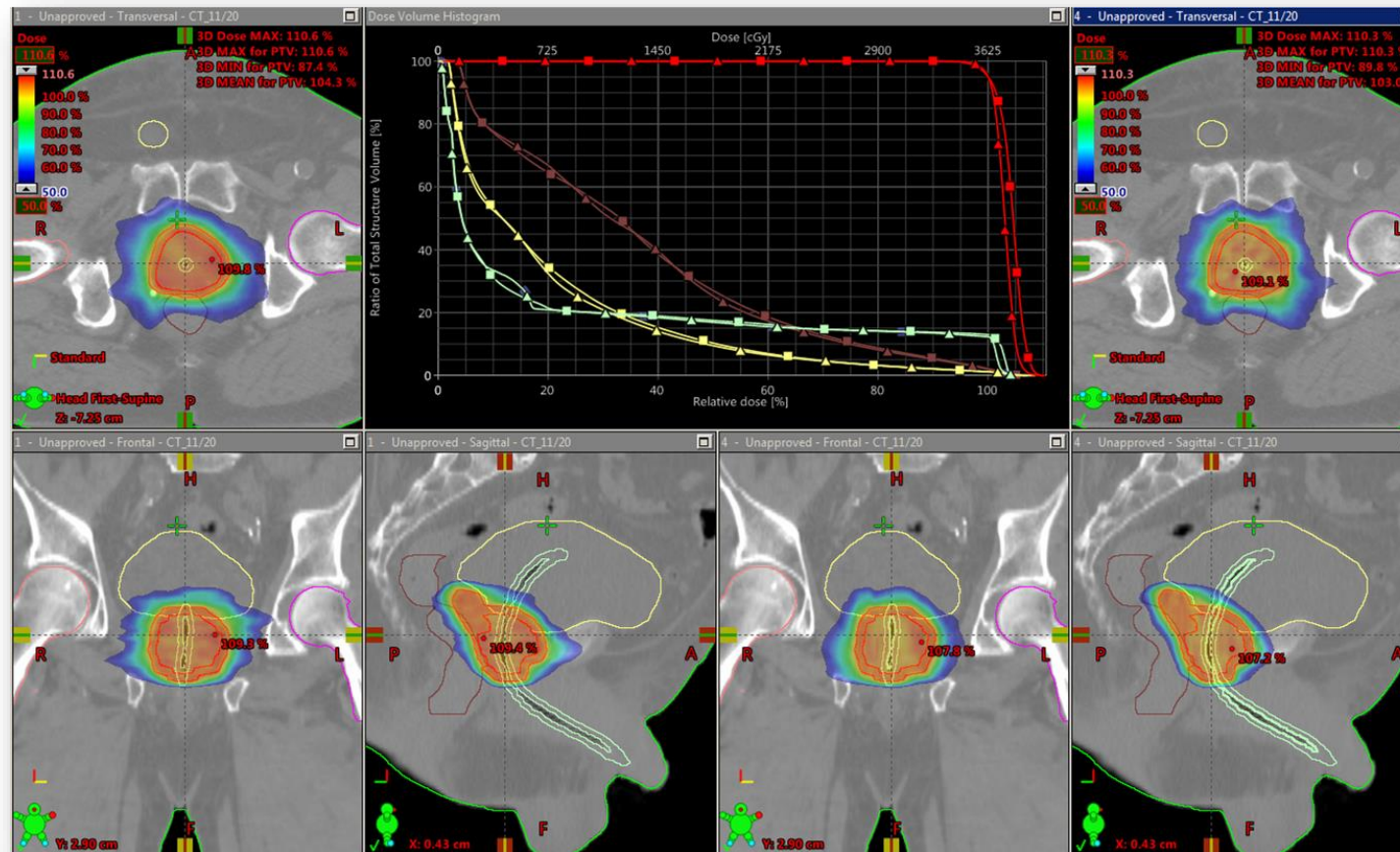
PLANEJAMENTO

COMO PLANEJAR ESSE PACIENTE?

- Técnica VMAT: Arcos únicos
- Energia: 6SRS (1000MU/min)

Arco Único col 10:

2662 MUs



Arco Único col 85:

2572 MUs





PLANEJAMENTO

COMO AVALIAR O PLANO?

PACE Dose Constraints.⁷⁸

Organ At Risk	Dose Constraint
Rectum	V18.1 Gy <50% (ie, 50% rectum <18.1 Gy) V29 Gy <20% (ie, less than 20% rectum receiving 29 Gy) V36 Gy <1 cc
Bladder	V18.1 Gy <40% V37 Gy <10 cc (optimal V37 Gy <5 cc)
Prostatic urethra (if visualized)	V42 Gy <50% (optimal, not mandatory)
Femoral head	V14.5 Gy <5%
Penile bulb	V29.5 Gy <50%
Testicular	Blocking structure
Bowel	V18.1 Gy <5 cc V30 Gy <1 cc

Abbreviations: PACE, prostate advanced in comparative evidence; V, volume.

PACE Trial

5 Fraction Arm

Organ	Volume	Dosimetry Parameters for 5 fraction arm and with all delivery devices except CyberKnife **	Dosimetry Parameters for 5 fraction arm and treatment with CyberKnife
Prostate (PTV)	Maximum point dose (0.03cc)	≤ 38.78 Gy 107% of prescription dose *	<43.5 Gy 120% of prescription dose *
	Minimum dose received by 95% of PTV	≥ 36.25 Gy 100% of prescription dose	Same
	Minimum dose received by PTV	≥ 34.4 Gy 95% of prescription dose	Same
Rectum	Maximum point dose (1cc)	≤ 38.06 Gy 105% of the prescription dose	Same
	Less than 3 cc	< 34.4 Gy 95% of prescription dose	Same
	90% rectum	≤ 32.625 Gy 90% of prescription dose	Same
	80% rectum	≤ 29 Gy 80% of prescription dose	Same
	50% rectum	≤ 18.125 Gy 50% of prescription dose	Same
Bladder	Maximum point dose (1cc)	≤ 38.06 Gy 105% of prescription dose	Same
	90% Bladder	≤ 32.625 Gy 90% of prescription dose	Same
	50% Bladder	≤ 18.125 Gy 50% of prescription dose	Same
Penile bulb (recommended)	Maximum point dose	No more than 100% of prescription dose	Same
	Less than 3 cc	20 Gy 54% of prescription dose	Same
Femoral heads	Less than 10 cc cumulative (both sides)	20 Gy 54% of prescription dose	Same
Skin (recommended)	Maximum point dose	30 Gy 81% of prescription dose	Same
Urethra dose		≤ 38.78 Gy * 107% of prescription dose	Same

RTOG 0938

Constraints:

Variam com Protocolo Clínico escolhido

HMD: RTOG 0938



PLANEJAMENTO

COMO AVALIAR O PLANO?

Protocolo Clínico

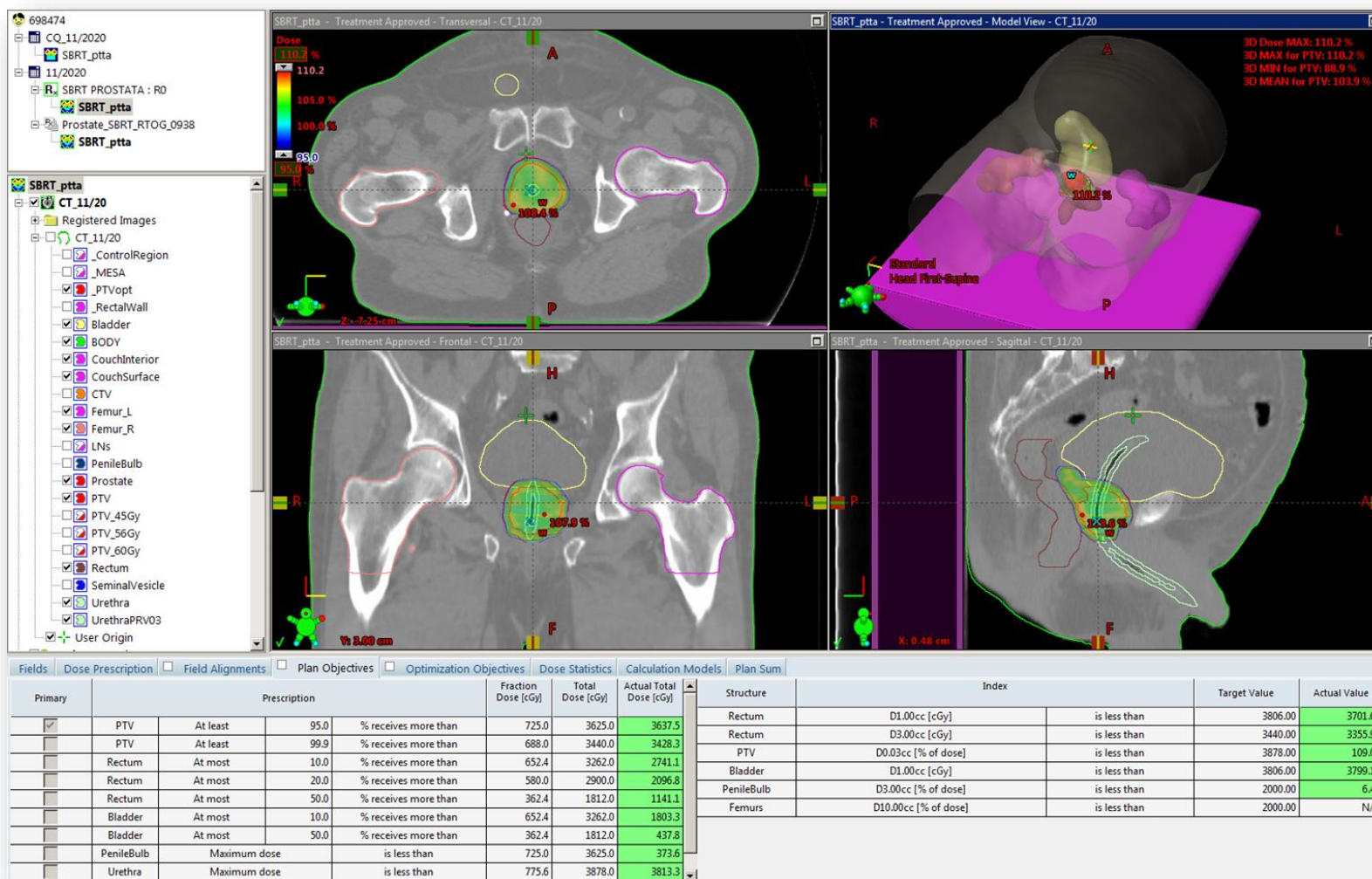
- Padronização na avaliação
- Agilidade e SEGURANÇA
- Não substitui análise criteriosa e QUALITATIVA



Constraints:

Variam com Protocolo Clínico escolhido

HMD: RTOG 0938



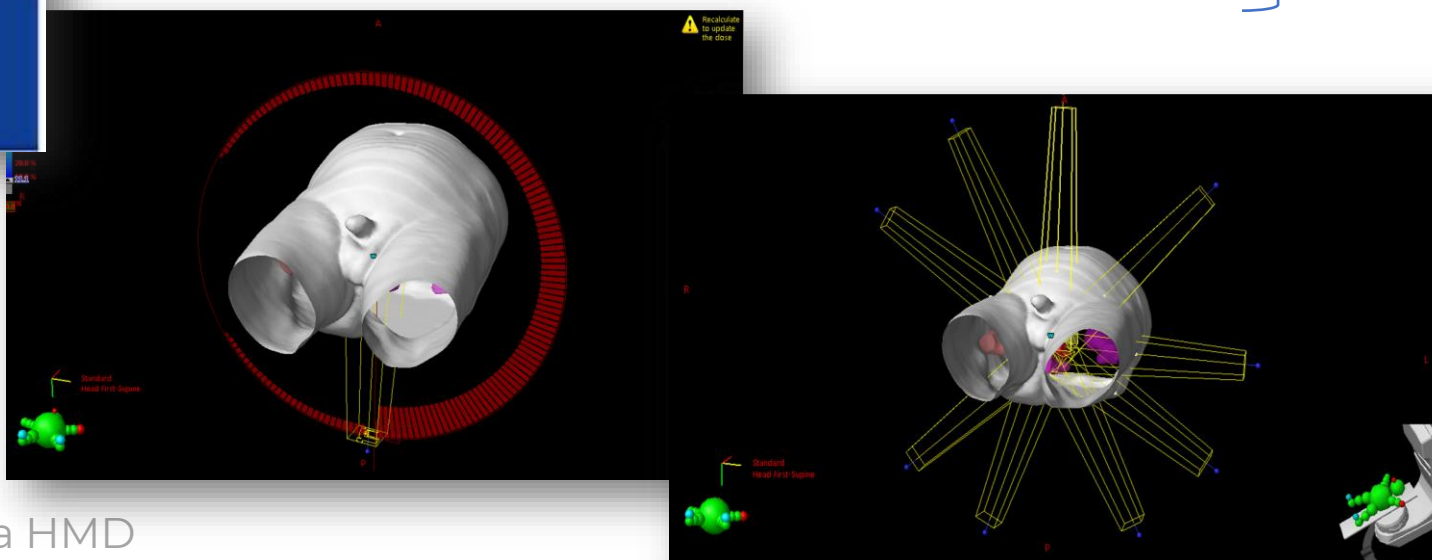


PLANEJAMENTO

PRÓTESE É CONTRA INDICAÇÃO?

*"...In the presence of hip prostheses, **skip arcs** which prevent direct beam entry through the prosthetic device can be considered. However, in such a scenario, IMRT with seven to nine **fixed fields** may still be particularly useful due to the ability to more carefully control the beam directions and dose entering through the prosthetic devices."*

- Evitar setores
- Usar campos fixos
- Ferramentas de otimização





O NOVO CONVENCIONAL (?)

- Hipofracionamento moderado: $\approx 2,5 - 3,0$ Gy/dia
- SBRT: $\approx 6 - 20$ Gy/dia; 3 a 5 aplicações



Loading...



- SBRT: Próstata + Drenagens
- SBRT/SRS: $\approx 20 - 24$ Gy/dia; Aplicação Única

FUTURO

IDENTIFICAR POSSIBILIDADES

ESTUDAR

EXECUTAR

AVALIAR

AJUSTAR





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Hospital Mãe de Deus

Porto Alegre - RS



HOSPITAL DO CÂNCER
MÃE DE DEUS
SISTEMA DE SAÚDE MÃE DE DEUS