

Setup e Imagens – Planejamentos para tratamentos hipofracionados: Quais os pontos de atenção?

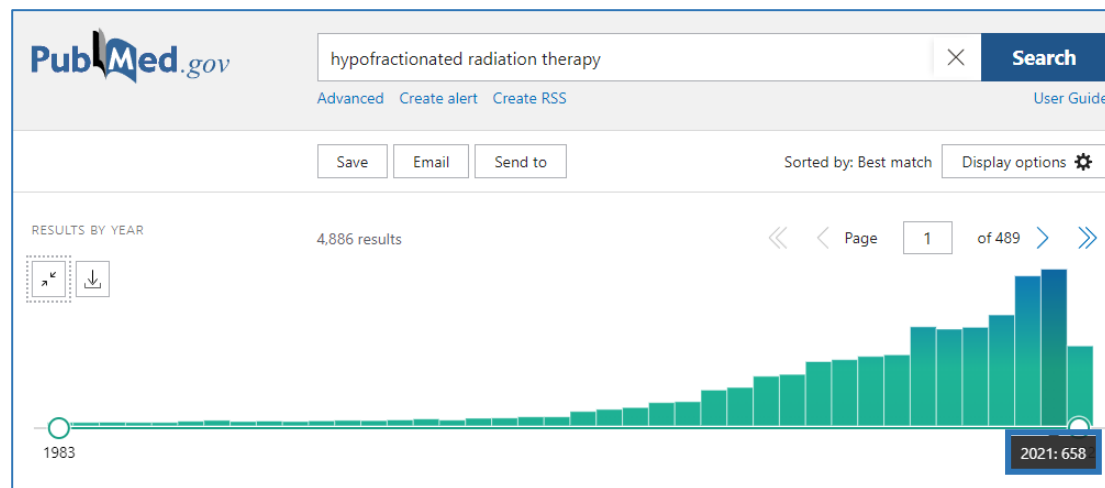
Felipe Rodrigues Barreto

Especialista em Física da Radioterapia
Doutor em Física Aplicada a Medicina e Biologia – USP

Clínica São Vicente da Gávea – Oncologia Rede D'Or

Agosto - 2022

Prevalência do hipofracionamento



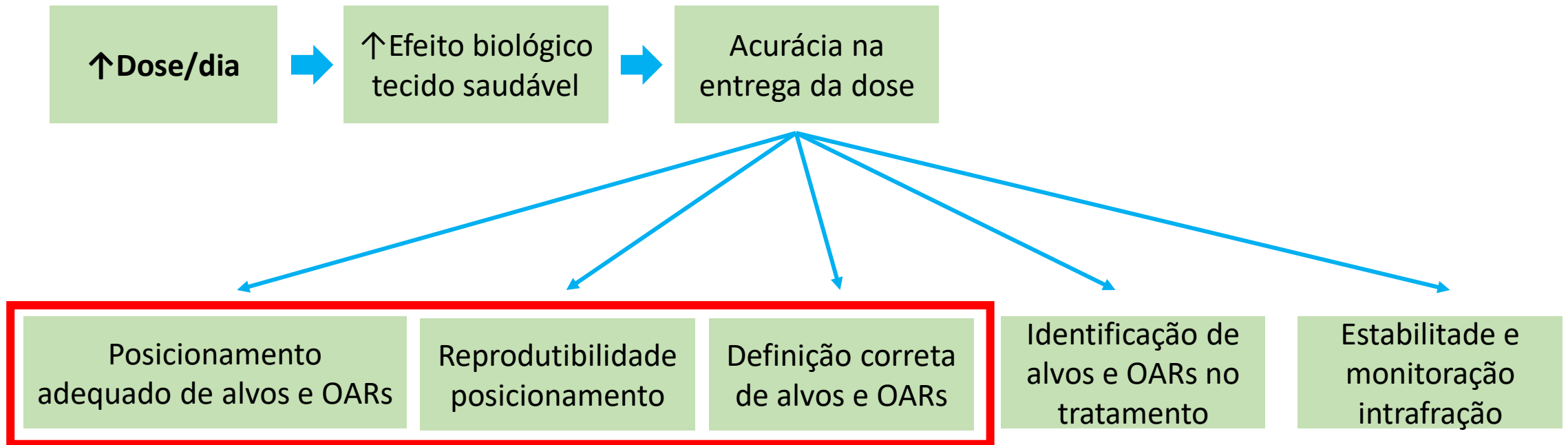
Distribuição proporcional dos dez tipos de câncer mais incidentes estimados para 2020 por sexo, exceto pele não melanoma*

Localização Primária	Casos	%	Homens	Mulheres	Localização Primária	Casos	%
Próstata	65.840	29,2%			Mama feminina	66.280	29,7%
Colo e reto	20.520	9,1%			Colo e reto	20.470	9,2%
Traqueia, brônquio e pulmão	17.760	7,9%			Colo do útero	16.500	7,4%
Estômago	13.360	5,9%			Traqueia, brônquio e pulmão	12.440	5,6%
Cavidade oral	11.180	5,0%			Glandula tireoide	11.950	5,4%
Esôfago	8.690	3,9%			Estômago	7.870	3,5%
Bexiga	7.590	3,4%			Ovário	6.650	3,0%
Linfoma não Hodgkin	6.580	2,9%			Corpo do útero	6.540	2,9%
Laringe	6.470	2,9%			Linfoma não Hodgkin	5.450	2,4%
Leucemias	5.920	2,6%			Sistema nervoso central	5.220	2,3%

*Números arredondados para múltiplos de 10.

Fonte: Estimativa 2020 Incidência Cancer no Brasil – Ministério da Saúde - INCA

Tratamento convencional vs hipofracionado



Simulação e contorno

Pontos de atenção na simulação:

- Hipof. Mama
- Hipof. Meta Óssea
- Hipof. Abdômen (fígado, pâncreas e adrenal)
- Hipof. Próstata
- Hipof. Pulmão

Hipofracionamento de Mama

Hipofracionamento de mama

Review > Lancet. 2011 Nov 12;378(9804):1707-16. doi: 10.1016/S0140-6736(11)61629-2. Epub 2011 Oct 19.

Effect of radiotherapy after breast-conserving surgery on 10-year recurrence and 15-year breast cancer death: meta-analysis of individual patient data for 10,801 women in 17 randomised trials

Early Breast Cancer Trialists' Collaborative Group (EBCTCG); S Darby, P McGale, C Correa, C Taylor, R Arriagada, M Clarke, D Cutter, C Davies, M Ewertz, J Godwin, R Gray, L Pierce, T Whelan, Y Wang, R Peto

Collaborators + expand

PMID: 22019144 PMCID: [PMC3254252](#) DOI: 10.1016/S0140-6736(11)61629-2



50Gy@25f

Clinical Trial > Lancet Oncol. 2019 Mar;20(3):352-360. doi: 10.1016/S1470-2045(18)30813-1. Epub 2019 Jan 30.

Hypofractionated versus conventional fractionated postmastectomy radiotherapy for patients with high-risk breast cancer: a randomised, non-inferiority, open-label, phase 3 trial

Shu-Lian Wang¹, Hui Fang¹, Yong-Wen Song¹, Wei-Hu Wang¹, Chen Hu², Yue-Ping Liu¹, Jing Jin¹, Xin-Fan Liu¹, Zi-Hao Yu¹, Hua Ren¹, Ning Li¹, Ning-Ning Lu¹, Yu Tang¹, Yuan Tang¹, Shu-Nan Qi¹, Guang-Yi Sun¹, Ran Peng¹, Shuai Li¹, Bo Chen¹, Yong Yang¹, Ye-Xiong Li³

Affiliations + expand

PMID: 30711522 DOI: [10.1016/S1470-2045\(18\)30813-1](#)



50Gy@25f vs 43.5Gy@15f

Clinical Trial > Lancet. 2020 May 23;395(10237):1613-1626. doi: 10.1016/S0140-6736(20)30932-6. Epub 2020 Apr 28.

Hypofractionated breast radiotherapy for 1 week versus 3 weeks (FAST-Forward): 5-year efficacy and late normal tissue effects results from a multicentre, non-inferiority, randomised, phase 3 trial

Adrian Murray Brunt¹, Joanne S Haviland², Duncan A Wheatley³, Mark A Sydenham², Abdulla Alhasso⁴, David J Bloomfield⁵, Charlie Chan⁶, Mark Churn⁷, Susan Cleator⁸, Charlotte E Coles⁹, Andrew Goodman¹⁰, Adrian Harnett¹¹, Penelope Hopwood², Anna M Kirby¹², Cliona C Kirwan¹³, Carolyn Morris¹⁴, Zohal Nabi¹⁵, Elinor Sawyer¹⁶, Navita Somaiah¹², Liba Stones², Isabel Syndikus¹⁷, Judith M Bliss², John R Yarnold¹², FAST-Forward Trial Management Group

Collaborators, Affiliations + expand

PMID: 32580883 PMCID: [PMC7262592](#) DOI: 10.1016/S0140-6736(20)30932-6



40Gy@15f vs 26Gy@5f

Radiation therapy for the whole breast: Executive summary of an American Society for Radiation Oncology (ASTRO) evidence-based guideline

Benjamin D Smith ¹, Jennifer R Bellon ², Rachel Blitzblau ³, Gary Freedman ⁴, Bruce Haffty ⁵, Carol Hahn ⁶, Francine Halberg ⁷, Karen Hoffman ⁸, Kathleen Horst ⁹, Jean Moran ¹⁰, Caroline Patton ¹¹, Jane Perlmutter ¹², Laura Warren ², Timothy Whelan ¹³, Jean L Wright ¹⁴, Reshma Jagsi ¹⁰

Table 1 Patients for whom consensus supports use of HF-WBI: A comparison of the 2011 and 2018 ASTRO Guidelines *

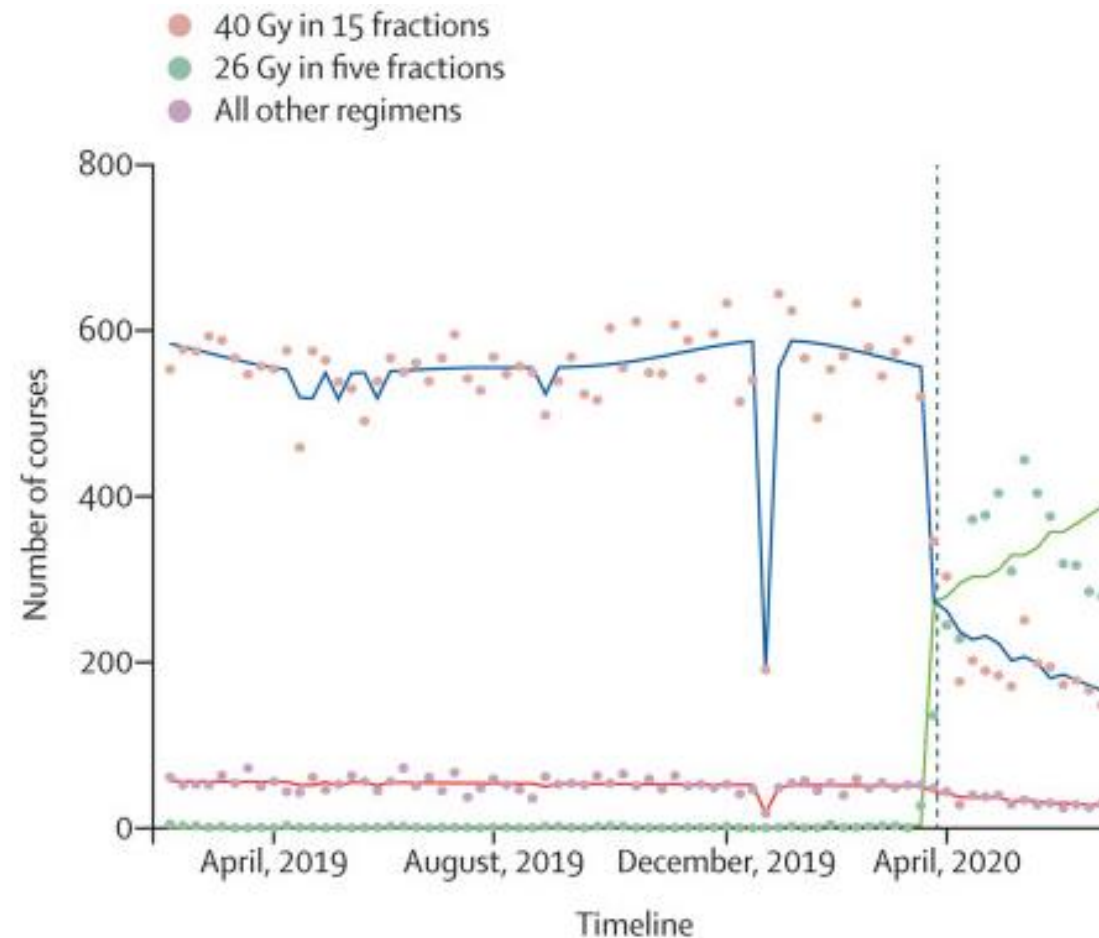
Factor	2011 Guideline	2018 Guideline
Age	≥50 years	Any
Stage	T1-2 N0	Any stage provided intent is to treat the whole breast without an additional field to cover the regional lymph nodes
Chemotherapy	None	Any chemotherapy
Dose homogeneity	±7% in the central axis	Volume of breast tissue receiving >105% of the prescription dose should be minimized regardless of dose-fractionation

ASTRO, American Society for Radiation Oncology; HF-WBI, hypofractionated whole-breast irradiation.

* These guidelines are intended as a tool to promote appropriately individualized, shared decision-making between physicians and patients. None should be construed as strict or superseding the appropriately informed and considered judgments of individual physicians and patients; therefore, the task force recommends against any quality benchmarks requiring 100% utilization of HF-WBI, even in patients where recommendations for HF-WBI are strong because the distribution of reasonable patient values and preferences would be expected to yield a patient-centered choice for conventionally fractionated WBI in a certain proportion of individual patients.

The impact of the COVID-19 pandemic on radiotherapy services in England, UK: a population-based study

Katie Spencer¹, Christopher M Jones², Rebecca Girdler³, Catherine Roe³, Michael Sharpe³, Sarah Lawton³, Louise Miller³, Philippa Lewis⁴, Mererid Evans⁵, David Sebag-Montefiore⁶, Tom Roques⁷, Rebecca Smittenaar³, Eva Morris⁸



Toxicidade cardíaca

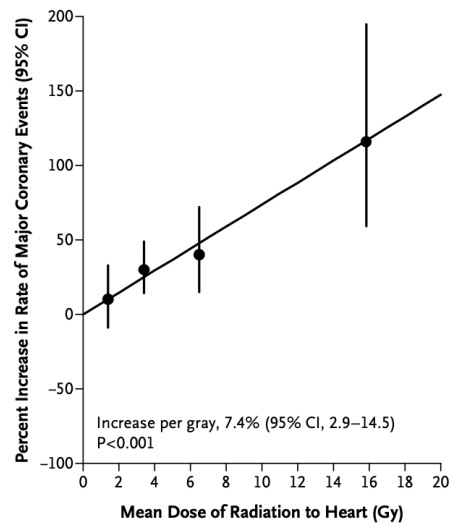
> N Engl J Med. 2013 Mar 14;368(11):987-98. doi: 10.1056/NEJMoa1209825.

Risk of ischemic heart disease in women after radiotherapy for breast cancer

Sarah C Darby¹, Marianne Ewertz, Paul McGale, Anna M Bennet, Ulla Blom-Goldman, Dorte Brønnum, Candace Correa, David Cutter, Giovanna Gagliardi, Bruna Gigante, Maj-Andrew Nisbet, Richard Peto, Kazem Rahimi, Carolyn Taylor, Per Hall

Affiliations + expand

PMID: 23484825 DOI: 10.1056/NEJMoa1209825



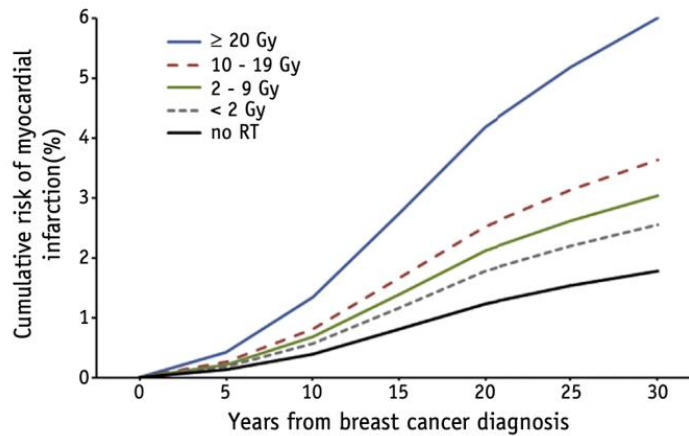
> Int J Radiat Oncol Biol Phys. 2019 Mar 1;103(3):595-604. doi: 10.1016/j.ijrobp.2018.10.025. Epub 2018 Oct 29.

Radiation Dose-Response for Risk of Myocardial Infarction in Breast Cancer Survivors

Judy N Jacobse¹, Frances K Duane², Naomi B Boekel¹, Michael Schaapveld¹, Michael Hauptmann³, Maartje J Hoening⁴, Caroline M Seynaeve⁴, Margreet H A Baaijens⁵, Jourik A Gietema⁶, Sarah C Darby⁷, Flora E van Leeuwen¹, Berthe M P Aleman⁸, Carolyn W Taylor⁷

Affiliations + expand

PMID: 30385276 PMCID: PMC6361769 DOI: 10.1016/j.ijrobp.2018.10.025



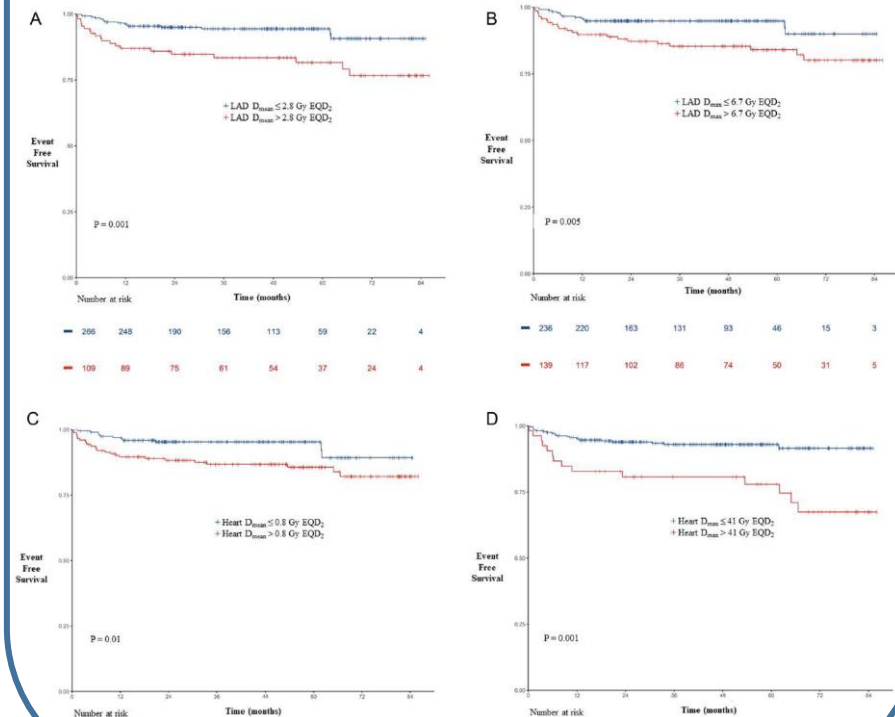
> Int J Radiat Oncol Biol Phys. 2022 Apr 25;S0360-3016(22)00332-7. doi: 10.1016/j.ijrobp.2022.04.019. Online ahead of print.

Dose to the Left Anterior Descending Artery Correlates With Cardiac Events After Irradiation for Breast Cancer

Andrew H Zureick¹, Vincent P Grzywacz¹, Muayad F Almahariq², Brittany R Silverman³, Aleksander Vayntraub¹, Peter Y Chen¹, Gregory S Gustafson⁴, Maha Saada Jawad¹, Joshua T Dilworth⁵

Affiliations + expand

PMID: 35483540 DOI: 10.1016/j.ijrobp.2022.04.019



Toxicidade cardíaca

> J Clin Oncol. 2005 Oct 20;23(30):7475-82. doi: 10.1200/JCO.2005.13.755. Epub 2005 Sep 12.

Cardiac morbidity of adjuvant radiotherapy for breast cancer

Debra A Patt ¹, James S Goodwin, Yong-Fang Kuo, Jean L Freeman, Dong D Zhang, Thomas A Buchholz, Gabriel N Hortobagyi, Sharon H Giordano

Affiliations + expand

PMID: 16157933 DOI: 10.1200/JCO.2005.13.755

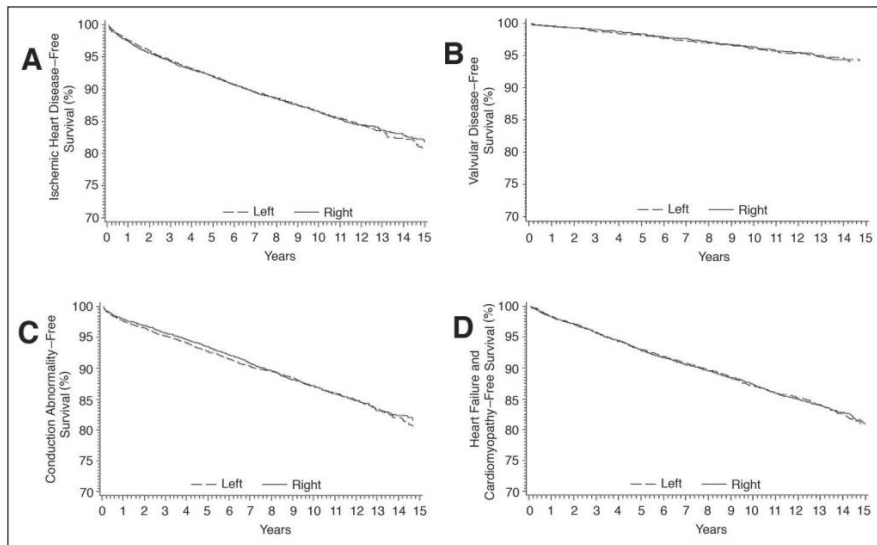


Fig 1. Kaplan-Meier time-to-event curves for patients with left- versus right-sided breast cancer for hospitalization for ischemic heart disease (A), valvular heart disease (B), conduction abnormalities (C), and heart failure (D).

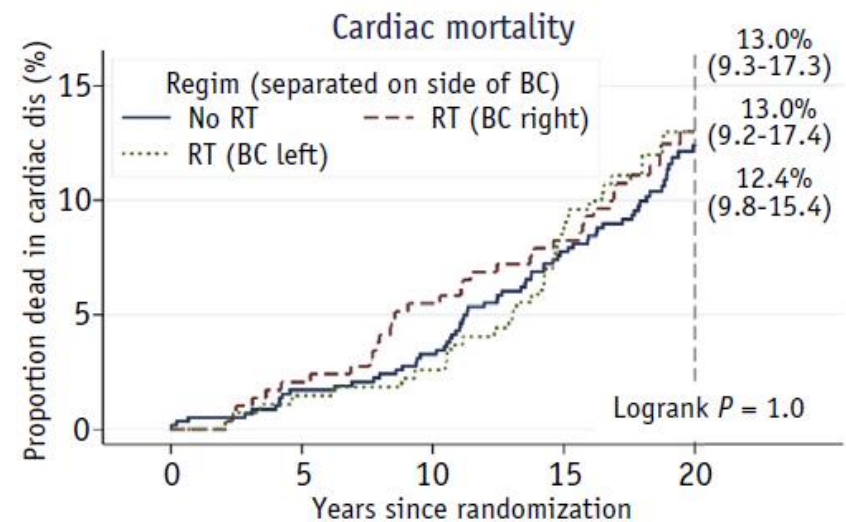
> Int J Radiat Oncol Biol Phys. 2020 Jul 15;107(4):701-709. doi: 10.1016/j.ijrobp.2020.04.003. Epub 2020 Apr 14.

No Increased Cardiac Mortality or Morbidity of Radiation Therapy in Breast Cancer Patients After Breast-Conserving Surgery: 20-Year Follow-up of the Randomized SweBCGRT Trial

Fredrika Killander ¹, Elinore Wieslander ², Per Karlsson ³, Erik Holmberg ⁴, Dan Lundstedt ³, Lars Holmberg ⁵, Linda Werner ⁶, Sasha Koul ⁷, Mahnaz Haghanegi ², Elisabeth Kjellen ⁸, Per Nilsson ⁹, Per Malmström ⁸

Affiliations + expand

PMID: 32302682 DOI: 10.1016/j.ijrobp.2020.04.003



Hipofracionamento de mama

Simulação convencional



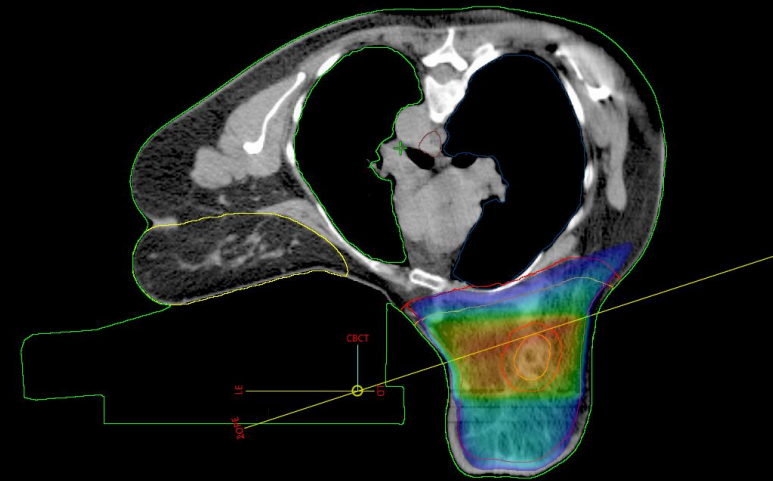
Hipofracionamento de mama

Simulação convencional – AIO Orfit



Hipofracionamento de mama

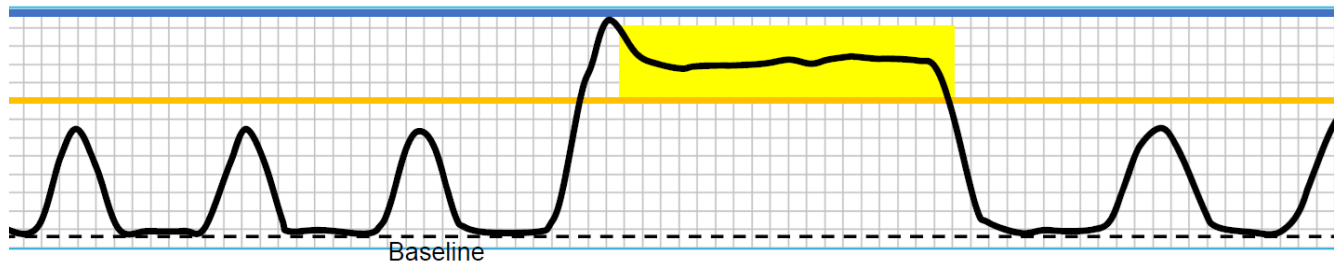
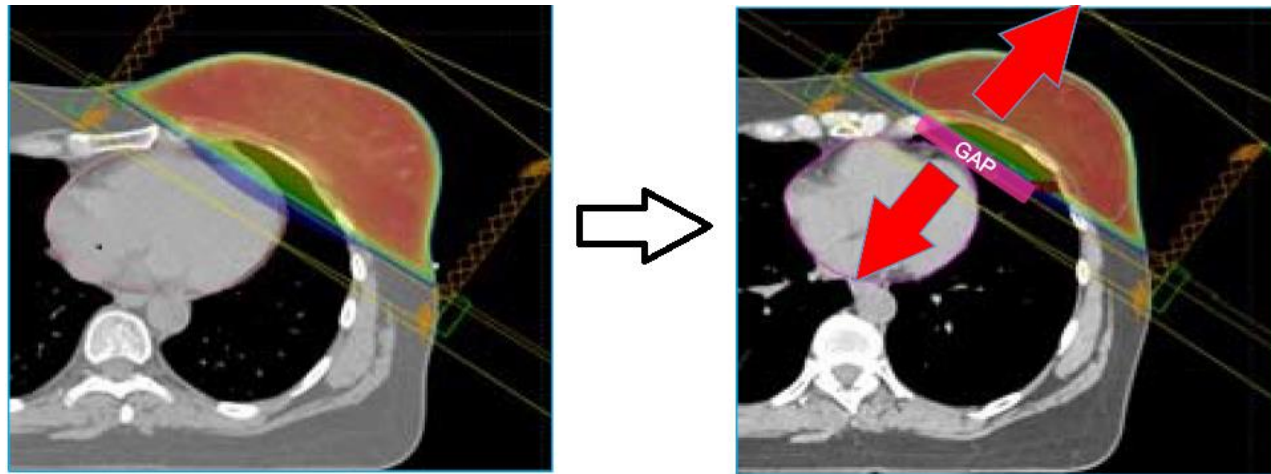
Simulação em Mama Prona – AIO Orfit



- Reprodutibilidade diária pode ser complexa.
- Mama contralateral pode gerar desconforto.

Hipofracionamento de mama

Simulação com retenção de fôlego (DIBH - Deep Inspiration Breath-Hold)



Real-time Position Management - Varian



Active Breathing Coordinator (ABC) –Elekta

Hipofracionamento de mama

Pontos de atenção no hipofracionamento de mama!

→ Não são necessárias alterações no setup de mama convencional.

→ Imagens com cortes de 3 mm são compatíveis com as dimensões dos alvos.

→ Imagens multimodais não são necessárias para auxílio do contorno médico.

> Pract Radiat Oncol. May-Jun 2018;8(3):145-152. doi: 10.1016/j.prro.2018.01.012. Epub 2018 Mar 12.

Radiation therapy for the whole breast: Executive summary of an American Society for Radiation Oncology (ASTRO) evidence-based guideline

Benjamin D Smith¹, Jennifer R Bellon², Rachel Blitzblau³, Gary Freedman⁴, Bruce Haffty⁵, Carol Hahn⁶, Francine Halberg⁷, Karen Hoffman⁸, Kathleen Horst⁹, Jean Moran¹⁰, Caroline Patton¹¹, Jane Perlmutter¹², Laura Warren², Timothy Whelan¹³, Jean L Wright¹⁴, Reshma Jagsi¹⁰

Affiliations + expand

PMID: 29545124 DOI: 10.1016/j.prro.2018.01.012

Cardiac delineation and avoidance

Statement KQ4C. The heart should be contoured on the treatment planning computed tomography scan in accordance with Radiation Therapy Oncology Group guidelines. Tangent beams should be delineated to minimize the dose to the heart. The mean heart dose should be as low as reasonably achievable. Deep inspiration breath hold, prone positioning, and/or heart blocks are recommended to minimize heart dose. Judicious tailoring of the whole breast dose coverage may be used to minimize the dose to the heart, provided that the tumor bed is remote from this region of the breast.

Hipofracionamento de Próstata

Hipofracionamento de próstata

Randomized Controlled Trial > J Clin Oncol. 2017 Jun 10;35(17):1884-1890.
doi: 10.1200/JCO.2016.71.7397. Epub 2017 Mar 15.

Randomized Trial of a Hypofractionated Radiation Regimen for the Treatment of Localized Prostate Cancer

Charles N Catton¹, Himu Lukka¹, Chu-Shu Gu¹, Jarad M Martin¹, Stéphane Supiot¹, Peter W M Chung¹, Glenn S Bauman¹, Jean-Paul Bahary¹, Shahida Ahmed¹, Patrick Cheung¹, Keen Hun Tai¹, Jackson S Wu¹, Matthew B Parliament¹, Theodoros Tsakiridis¹, Tom B Corbett¹, Colin Tang¹, Ian S Dayes¹, Pdraig Warde¹, Tim K Craig¹, Jim A Julian¹, Mark N Levine¹

Affiliations + expand

PMID: 28296582 DOI: 10.1200/JCO.2016.71.7397



78Gy@39f vs 60Gy@20f

Clinical Trial > Lancet Oncol. 2016 Aug;17(8):1047-1060. doi: 10.1016/S1470-2045(16)30102-4.
Epub 2016 Jun 20.

Conventional versus hypofractionated high-dose intensity-modulated radiotherapy for prostate cancer: 5-year outcomes of the randomised, non-inferiority, phase 3 CHHiP trial

David Dearnaley¹, Isabel Syndikus², Helen Mossop³, Vincent Khoo⁴, Alison Birtle⁵, David Bloomfield⁶, John Graham⁷, Peter Kirkbride⁸, John Logue⁹, Zafar Malik², Julian Money-Kyrle¹⁰, Joe M O'Sullivan¹¹, Miguel Panades¹², Chris Parker⁴, Helen Patterson¹³, Christopher Scrase¹⁴, John Staffurth¹⁵, Andrew Stockdale¹⁶, Jean Tremlett⁶, Margaret Bidmead¹⁷, Helen Mayles², Olivia Naismith¹⁷, Chris South¹⁰, Annie Gao⁴, Clare Cruickshank³, Shama Hassan³, Julia Pugh³, Clare Griffin³, Emma Hall³, CHHiP Investigators

Affiliations + expand

PMID: 27339115 PMCID: PMC4961874 DOI: 10.1016/S1470-2045(16)30102-4



74Gy@37f vs 60Gy@20f

Clinical Trial > J Clin Oncol. 2016 Jul 10;34(20):2325-32. doi: 10.1200/JCO.2016.67.0448.
Epub 2016 Apr 4.

Randomized Phase III Noninferiority Study Comparing Two Radiotherapy Fractionation Schedules in Patients With Low-Risk Prostate Cancer

W Robert Lee¹, James J Dignam², Mahul B Amin², Deborah W Bruner², Daniel Low², Gregory P Swanson², Amit B Shah², David P D'Souza², Jeff M Michalski², Ian S Dayes², Samantha A Seaward², William A Hall², Paul L Nguyen², Thomas M Pisansky², Sergio L Faria², Yuhchayau Chen², Bridget F Koontz², Rebecca Paulus², Howard M Sandler²

Affiliations + expand

PMID: 27044935 PMCID: PMC4981980 DOI: 10.1200/JCO.2016.67.0448



73.8Gy@41f vs 70Gy@28f

Hipofracionamento de leito prostático

INTERNATIONAL JOURNAL OF
RADIATION ONCOLOGY • BIOLOGY • PHYSICS Log in

3 | VOLUME 111, ISSUE 3, SUPPLEMENT, S2-S3, NOVEMBER 01, 2021

**Primary Endpoint Analysis of a Randomized Phase III Trial of
Hypofractionated vs. Conventional Post-Prostatectomy Radiotherapy: NRG
Oncology GU003**

M.K. Buyyounouski  • S. Pugh • R.C. Chen • ... C.E. Duncan • J. Rodgers • H.M. Sandler • [Show all authors](#)

DOI: <https://doi.org/10.1016/j.ijrobp.2021.07.041>



66.6Gy@37f vs 62.5Gy@25f

Ultrahipofracionamento de próstata

Clinical Trial > Lancet Oncol. 2021 Feb;22(2):235-245. doi: 10.1016/S1470-2045(20)30581-7.

Epub 2021 Jan 11.

Ultra-hypofractionated versus conventionally fractionated radiotherapy for prostate cancer (HYPO-RT-PC): patient-reported quality-of-life outcomes of a randomised, controlled, non-inferiority, phase 3 trial

Per Fransson¹, Per Nilsson², Adalsteinn Gunnlaugsson², Lars Beckman³, Björn Tavelin⁴, David Norman⁴, Camilla Thellenberg-Karlsson⁴, Morten Hoyer⁵, Magnus Lagerlund⁶, Jon Kindblom⁷, Claes Ginman⁸, Bengt Johansson⁹, Kirsten Björnlinger¹⁰, Mihajl Seke¹¹, Måns Agrup¹², Björn Zackrisson⁴, Elisabeth Kjellén², Lars Franzén⁴, Anders Widmark⁴



78Gy@39f vs 42.7Gy@7f

Clinical Trial > Lancet Oncol. 2019 Nov;20(11):1531-1543. doi: 10.1016/S1470-2045(19)30569-8.

Epub 2019 Sep 17.

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 Brand¹, Alison C Tree¹, Peter Ostler², Hans van der Voet³, Andrew Loblaw⁴, William Chu⁴, Daniel Ford⁵, Shaun Tolan⁶, Suneil Jain⁷, Alexander Martin⁸, John Staffurth⁹, Philip Camilleri¹⁰, Kiran Kancherla¹¹, John Frew¹², Andrew Chan¹³, Ian S Dayes¹⁴, Daniel Henderson⁵, Stephanie Brown¹⁵, Clare Cruickshank¹⁵, Stephanie Burnett¹⁵, Aileen Duffton¹⁶, Clare Griffin¹⁵, Victoria Hinder¹⁵, Kirsty Morrison¹, Olivia Naismith¹⁷, Emma Hall¹⁵, Nicholas van As¹⁸, PACE Trial Investigators



78Gy@39f vs 62Gy@20f vs 36.25@5f

Hipofracionamento de próstata

Desafio: garantir a reprodutibilidade e acertar o alvo!



Aumento dose/dia



Diminuição das
margens



Reprodutibilidade

Hipofracionamento de próstata

> Int J Radiat Oncol Biol Phys. 2005 Jul 15;62(4):965-73. doi: 10.1016/j.ijrobp.2004.11.032.

Increased risk of biochemical and local failure in patients with distended rectum on the planning CT for prostate cancer radiotherapy

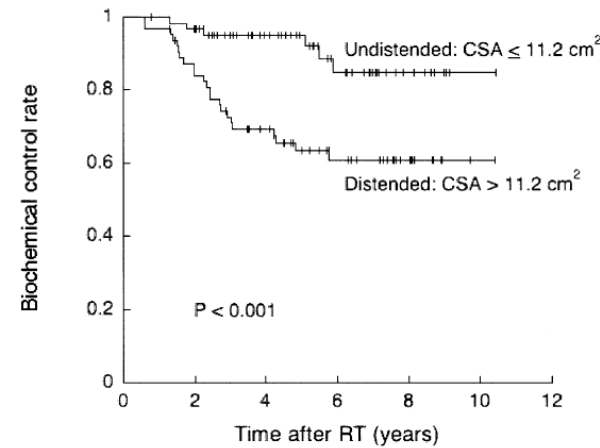
Renaud de Crevoisier¹, Susan L Tucker, Lei Dong, Radhe Mohan, Rex Cheung, James D Cox, Deborah A Kuban

Importância de uma bom preparo na TC de planejamento.

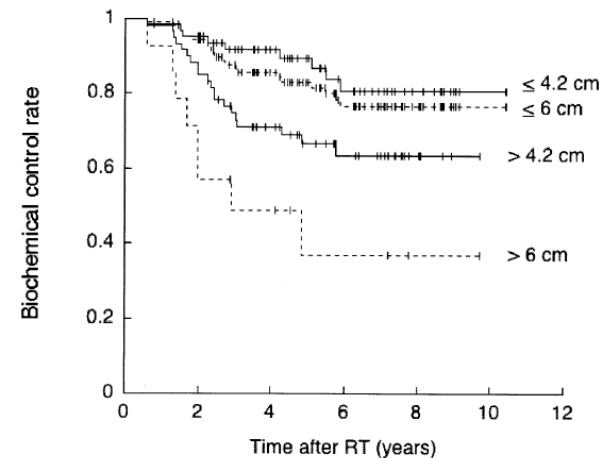
→ Prescrição: 78Gy@39fx;

→ Sem fiduciais;

→ Filme semanal.

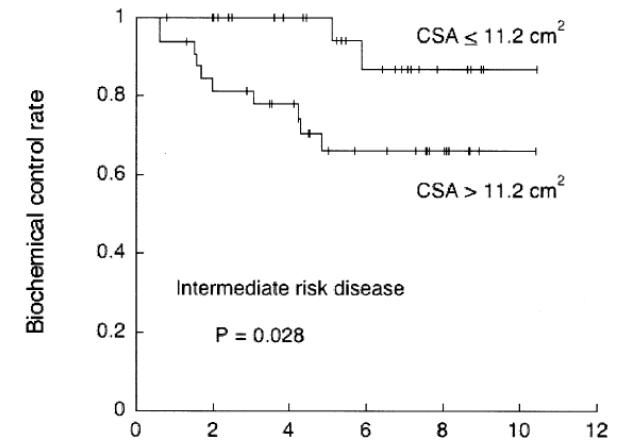


(a)

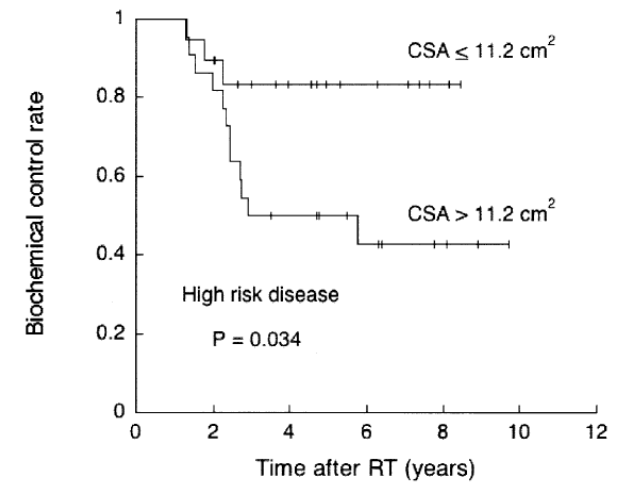


(b)

Fig. 3. (a) Biochemical control by rectal distension according to cross-sectional rectal area (entire cohort divided in two groups at the median value of CSA). (b) Biochemical control by rectal distension according to rectal diameter at base of prostate (entire cohort divided into subgroups at the median value [solid curves] and at 6 cm by optimal cutoff-point analysis [dashed curves]). CSA = cross-sectional rectal area; RT = radiotherapy.



(a)



(b)

Fig. 4. (a) Biochemical control by rectal distension (median cross-sectional rectal area) for intermediate-risk group. (b) Biochemical control by rectal distension (median cross-sectional rectal area) for high-risk group. CSA = Cross-sectional rectal area; RT = radiotherapy.

Hipofracionamento de próstata

Diretrizes para o preparo em nossa instituição:

Preparo para Reto

Alimentos a serem evitados:

- Cereais integrais (arroz, pão, biscoitos e barras de cereal, granola);
- Oleaginosas;
- Frituras e alimentos gordurosos;
- Derivados do leite;
- Grãos como feijão, ervilha, lentilha, grão de bico, soja;
- Alimentos picantes e muito condimentados;
- Bebidas alcoólicas;
- Bebidas gaseificadas.

Enzima Alfagalctosidade (Digeliv®) + Simeticona (Luftal®) para controle de gases.

Evacuar antes do tratamento ou supositório.

Preparo para Bexiga

Manter-se hidratado, ingerindo ao menos 2L de água ao dia;

Preparo de bexiga iniciado ao se chegar na clínica:

→ 4 copos de água 40 min antes do tratamento.

Particularidades Ultrahipofracionamento

Paciente sempre faz uso do supositório antes de ir tratar.

Hipofracionamento de próstata

Review > BJU Int. 2014 Mar;113 Suppl 2:13-20. doi: 10.1111/bju.12624.

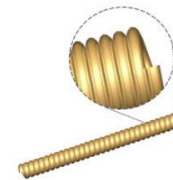
Fiducial markers and spacers in prostate radiotherapy: current applications

Michael Ng¹, Elizabeth Brown, Andrew Williams, Michael Chao, Nathan Lawrentschuk, Raphael Chee

- Ao menos 3 fiduciais devem ser utilizados;
- Localização: ápice, região média a direita e base a esquerda;
- Manter 3-5mm entre fiducial e borda da próstata;
- Ao menos 1 cm entre fiduciais.



Courtesy of CIVCO



Courtesy of IBA



Courtesy of Naslund Medical AB



Courtesy of Varian



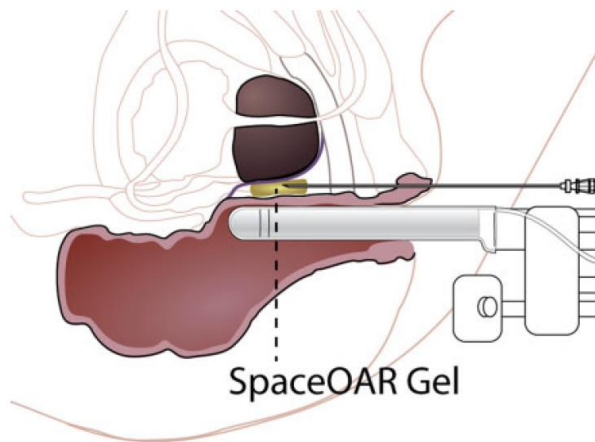
Hipofracionamento de próstata

Randomized Controlled Trial > Int J Radiat Oncol Biol Phys. 2015 Aug 1;92(5):971-977.

doi: 10.1016/j.ijrobp.2015.04.030. Epub 2015 Apr 23.

Hydrogel Spacer Prospective Multicenter Randomized Controlled Pivotal Trial: Dosimetric and Clinical Effects of Perirectal Spacer Application in Men Undergoing Prostate Image Guided Intensity Modulated Radiation Therapy

Neil Mariados¹, John Sylvester², Dhiren Shah³, Lawrence Karsh⁴, Richard Hudes⁵, David Beyer⁶, Steven Kurtzman⁷, Jeffrey Bogart⁸, R. Alex Hsi⁹, Michael Kos¹⁰, Rodney Ellis¹¹, Mark Logsdon¹², Shawn Zimberg¹³, Kevin Forsythe¹⁴, Hong Zhang¹⁵, Edward Soffen¹⁶, Patrick Francke¹⁷, Constantine Mantz¹⁸, Peter Rossi¹⁹, Theodore DeWeese²⁰, Daniel A Hamstra²¹, Walter Bosch²², Hiram Gay²², Jeff Michalski²²



Hydrogel Spacer

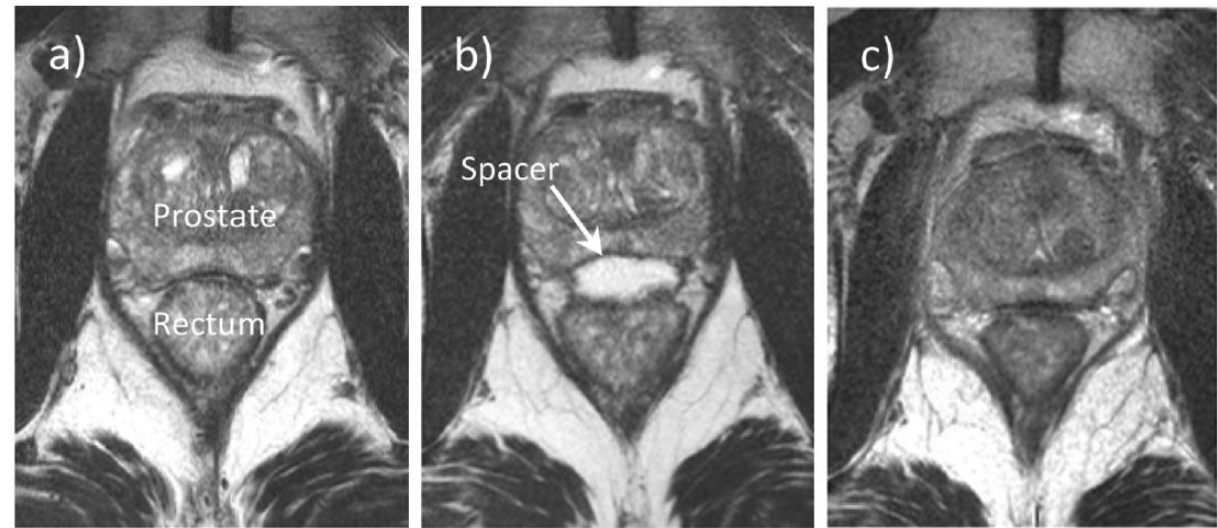


Fig. 1. T2-weighted magnetic resonance images of a spacer patient at baseline (a), post-application (b), and 12 months after spacer application (c).

Hipofracionamento de próstata

Clinical Trial > Int J Radiat Oncol Biol Phys. 2017 Apr 1;97(5):976-985.

doi: 10.1016/j.ijrobp.2016.12.024. Epub 2016 Dec 23.

Continued Benefit to Rectal Separation for Prostate Radiation Therapy: Final Results of a Phase III Trial

Daniel A Hamstra¹, Neil Mariados², John Sylvester³, Dhiren Shah⁴, Lawrence Karsh⁵, Richard Hudes⁶, David Beyer⁷, Steven Kurtzman⁸, Jeffrey Bogart⁹, R Alex Hsi¹⁰, Michael Kos¹¹, Rodney Ellis¹², Mark Logsdon¹³, Shawn Zimberg¹⁴, Kevin Forsythe¹⁵, Hong Zhang¹⁶, Edward Soffen¹⁷, Patrick Francke¹⁸, Constantine Mantz¹⁹, Peter Rossi²⁰, Theodore DeWeese²¹, Stephanie Daignault-Newton²², Benjamin W Fischer-Valuck²³, Anupama Chundury²³, Hiram Gay²³, Walter Bosch²³, Jeff Michalski²³

→ Prescrição: 79.2Gy@44fx

→ Ao menos 3 fiduciais implantados

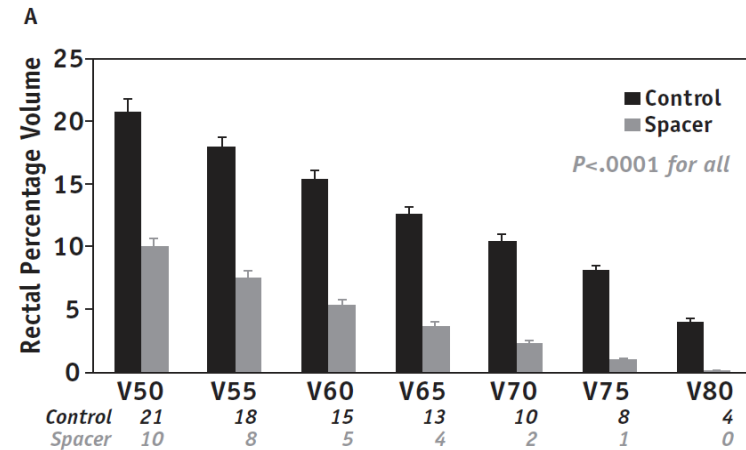


Fig. 1. Radiation dosimetry to rectum (A) and penile bulb (B) as a function of treatment arm. Doses presented as the mean $\pm$ standard error of the mean. Abbreviations: Dmax = maximum dose; pV(x) = the percentage of penile bulb at or above "x" Gy.

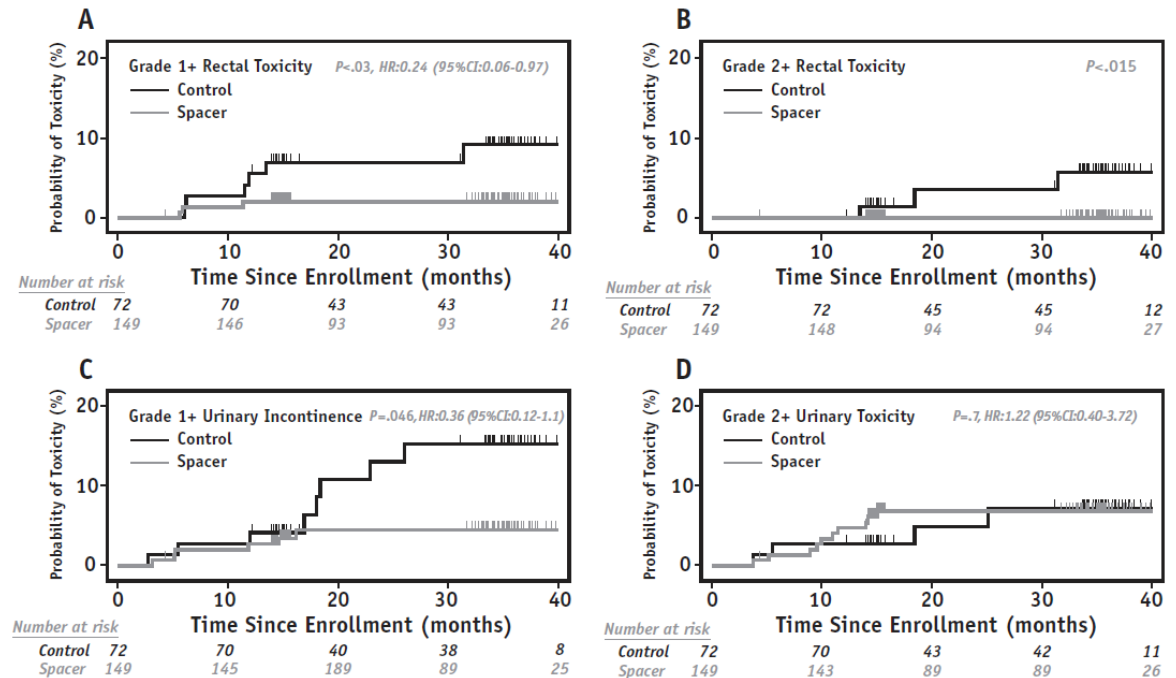


Fig. 2. The cumulative incidence of grade ≥ 1 (A) and ≥ 2 (B) bowel toxicity and grade ≥ 1 urinary incontinence (C) and grade ≥ 2 urinary toxicity (D). Abbreviations: CI = confidence interval; HR = hazard ratio.

Hipofracionamento de próstata

Pontos de atenção no hipofracionamento de próstata!

- Não há necessidade de alteração do setup convencional (decúbito dorsal + suporte joelho e/ou pés);
- A consistência na reprodutibilidade de reto e bexiga é peça chave na diminuição de margens e controle de toxicidade;
- Preparo de reto e bexiga é importante para garantir a qualidade do hipofracionamento;
- O uso de fiduciais pode ser uma solução na ausência de CBCT para o IGRT;
- Imagens de RM são importantes no contorno refinado da próstata e da uretra no ultrahipofracionamento;
- Imagens com cortes de 2 mm são compatíveis com as dimensões dos alvos.

Hipofracionamento de Meta Óssea

Hipofracionamento de Meta Óssea

> *Pract Radiat Oncol.* 2017 Jan-Feb;7(1):4-12. doi: 10.1016/j.prro.2016.08.001. Epub 2016 Aug 5.

Palliative radiation therapy for bone metastases: Update of an ASTRO Evidence-Based Guideline

Stephen Lutz¹, Tracy Balboni², Joshua Jones³, Simon Lo⁴, Joshua Petit⁵, Shayna E Rich⁶, Rebecca Wong⁷, Carol Hahn⁸



DU 8Gy vs frac

Review > *Radiother Oncol.* 2021 Oct;163:55-67. doi: 10.1016/j.radonc.2021.07.022.

Epub 2021 Jul 29.

Advances in radiotherapy in bone metastases in the context of new target therapies and ablative alternatives: A critical review

André G Gouveia¹, Dominic C W Chan², Peter J Hoskin³, Gustavo N Marta⁴, Fabio Trippa⁵, Ernesto Maranzano⁵, Edward Chow⁶, Mauricio F Silva⁷



RT ablativa em oligometástases

Clinical Trial > *Int J Radiat Oncol Biol Phys.* 2021 Jul 1;110(3):672-679.

doi: 10.1016/j.ijrobp.2021.01.004. Epub 2021 Jan 8.

Phase 3 Multi-Center, Prospective, Randomized Trial Comparing Single-Dose 24 Gy Radiation Therapy to a 3-Fraction SBRT Regimen in the Treatment of Oligometastatic Cancer

Michael J Zelefsky¹, Yoshiya Yamada², Carlo Greco³, Eric Lis⁴, Heiko Schöder⁵, Stephanie Lobaugh⁶, Zhigang Zhang⁶, Steve Braunstein⁷, Mark H Bilsky⁸, Simon N Powell², Richard Kolesnick⁹, Zvi Fuks²



Fase 3 – DU 24 Gy vs 3x9 Gy

Hipofracionamento de Meta Óssea

Impacto do setup no SBRT de coluna



Fig. 1. Spine SBRT immobilization devices: (a) evacuated cushion, (b) vacuum body fixation device, and (c) thermoplastic S-frame mask.

> Int J Radiat Oncol Biol Phys. 2012 Oct 1;84(2):520-6. doi: 10.1016/j.ijrobp.2011.12.039.
Epub 2012 Mar 6.

Impact of immobilization on intrafraction motion for spine stereotactic body radiotherapy using cone beam computed tomography

Winnie Li ¹, Arjun Sahgal, Matthew Foote, Barbara-Ann Millar, David A Jaffray, Daniel Letourneau

→ Percentil 95 similar para as três metodologias de imobilização.

Table 2 Translational displacements measured per immobilization cohort on CBCTs

Parameter	Localization CBCT			Verification CBCT			Mid-treatment CBCT			Post-treatment CBCT		
	R-L (mm)	C-C (mm)	A-P (mm)	R-L (mm)	C-C (mm)	A-P (mm)	R-L (mm)	C-C (mm)	A-P (mm)	R-L (mm)	C-C (mm)	A-P (mm)
Evacuated cushion (n = 24)	97 CBCTs			88 CBCTs			45 CBCTs			77 CBCTs		
Mean	0.8	0.7	-2.3	-0.1	-0.1	0.0	0.0	-0.2	0.0	-0.1	0.0	-0.1
SD	4.2	6.2	5.2	0.9	0.8	0.9	1.1	1.0	0.7	1.3	1.2	1.0
Max	-15.3	-16.1	-15.5	-3.5	-2.0	-3.5	-2.2	-2.3	-1.5	-3.5	-2.5	-3.6
Min	11.9	32.3	12.8	1.6	1.4	4.6	1.6	1.8	2.4	4.5	2.2	3.2
±2 SD	8.4	12.4	10.3	1.8	1.5	1.8	2.1	2.0	1.5	2.5	2.4	1.9
95th percentile	7.6	10.8	11.5	1.7	1.4	1.7	2.0	1.8	1.6	2.2	2.3	2.1
Vacuum fixation (n = 60)	194 CBCTs			184 CBCTs			160 CBCTs			150 CBCTs		
Mean	0.0	-6.2	-1.7	-0.2	0.2	0.0	-0.2	0.4	0.0	-0.2	0.4	0.0
SD	6.4	6.8	6.5	0.7	0.6	0.8	0.8	0.7	0.8	0.9	0.7	0.9
Max	-18.6	-20.8	-25.5	-2.7	-1.4	-2.0	-2.7	-2.0	-1.8	-2.5	-1.4	-2.4
Min	25.2	9.8	25.3	2.3	2.1	2.5	3.4	2.1	2.7	2.6	2.3	2.9
±2 SD	12.8	13.6	12.9	1.5	1.3	1.5	1.7	1.4	1.6	1.8	1.4	1.7
95th percentile	13.8	17.8	14.6	1.5	1.3	1.7	1.9	1.6	1.8	2.0	1.5	1.9
S frame Mask n = 18	64 CBCTs			61 CBCTs			43 CBCTs			53 CBCTs		
Mean	0.2	1.5	-0.4	0.1	-0.1	-0.2	0.2	0.0	-0.2	0.1	0.0	-0.2
SD	2.3	2.3	3.1	0.7	0.6	0.9	0.7	0.8	0.9	1.3	0.9	1.1
Max	-4.6	-8.0	-6.2	-1.5	-2.0	-2.2	-1.6	-1.4	-2.0	-2.5	-2.0	-2.6
Min	5.3	7.1	9.3	1.9	1.2	1.9	2.2	3.0	1.4	3.2	2.9	2.0
±2 SD	4.6	4.6	6.2	1.4	1.2	1.8	1.5	1.5	1.8	2.6	1.9	2.1
95th percentile	4.2	5.8	6.3	1.3	1.4	1.9	1.6	2.0	1.7	2.5	2.0	2.2

Abbreviations: CBCT = cone-beam computed tomography; R-L = right-left; C-C = cranial-caudal; A-P = anterior-posterior.

Hipofracionamento de Meta Óssea

Imagens intra-fração para verificação da posição

> Technol Cancer Res Treat. 2021 Jan-Dec;20:15330338211063033. doi: 10.1177/15330338211063033.

Triggered kV Imaging During Spine SBRT for Intrafraction Motion Management

Jihye Koo ^{1 2}, Louis Nardella ², Michael Degnan ³, Jacqueline Andreozzi ², Hsiang-Hsuan M Yu ², Jose Penagaricano ², Peter A S Johnstone ², Daniel Oliver ², Kamran Ahmed ², Stephen A Rosenberg ², Evan Wuthrick ², Roberto Diaz ², Vladimir Feygelman ², Kujtim Latifi ², Eduardo G Moros ², Gage Redler ²

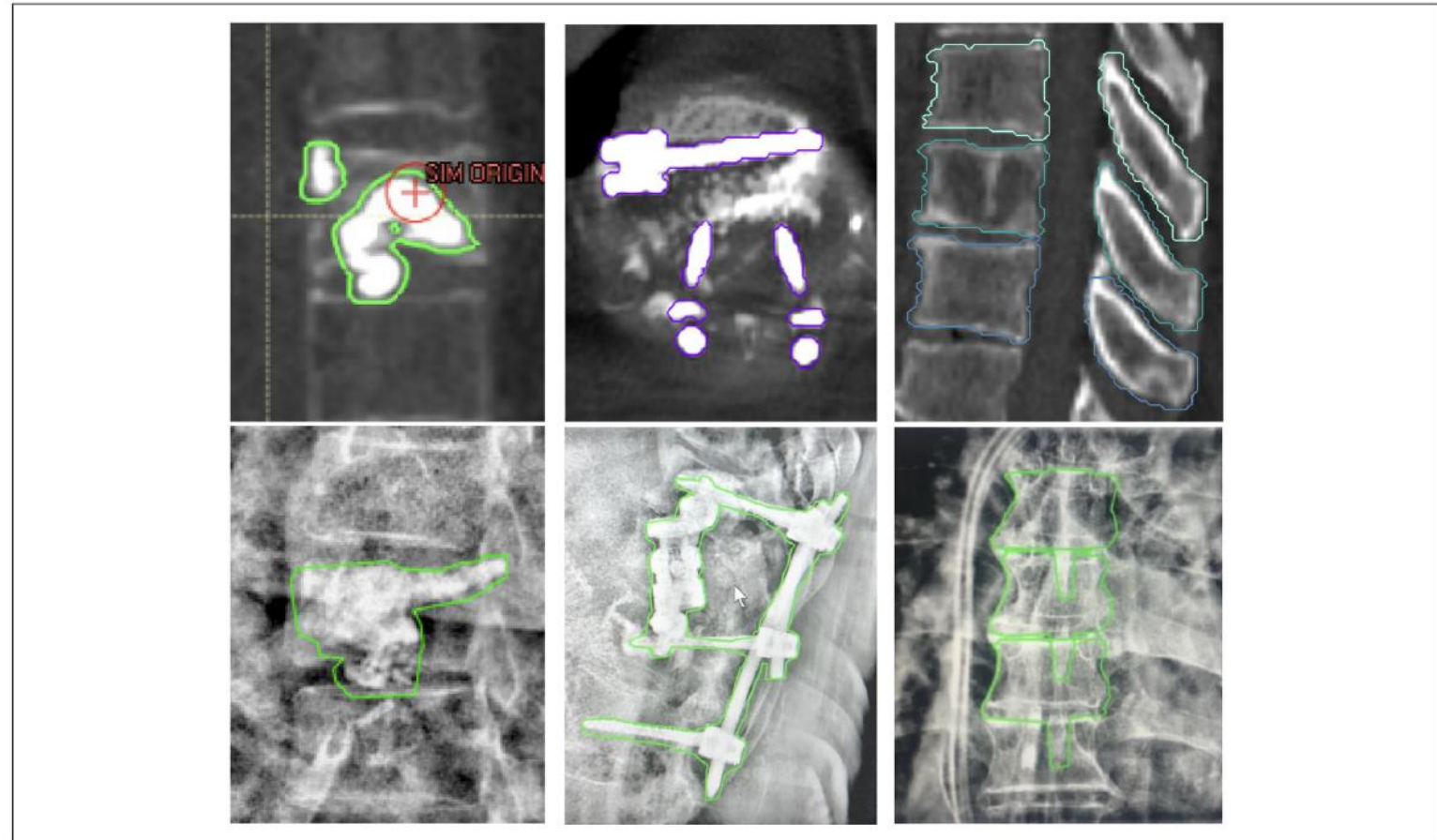


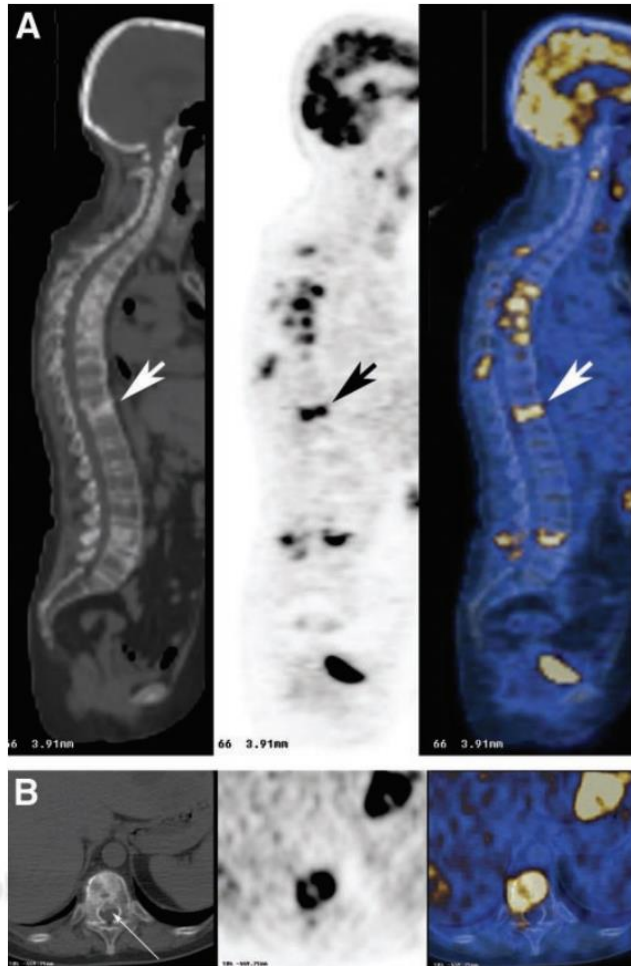
Figure 2. Example of the types of IGRT structures on planning CT (upper row) and projected onto triggered kV images (lower row). Bone cement (Left), orthopedic hardware implant (middle) and patient bony anatomy (vertebral body and spinous process, Right).

Hipofracionamento de Meta Óssea

Clinical Trial > J Nucl Med. 2004 Feb;45(2):279-84.

Malignant involvement of the spine: assessment by 18F-FDG PET/CT

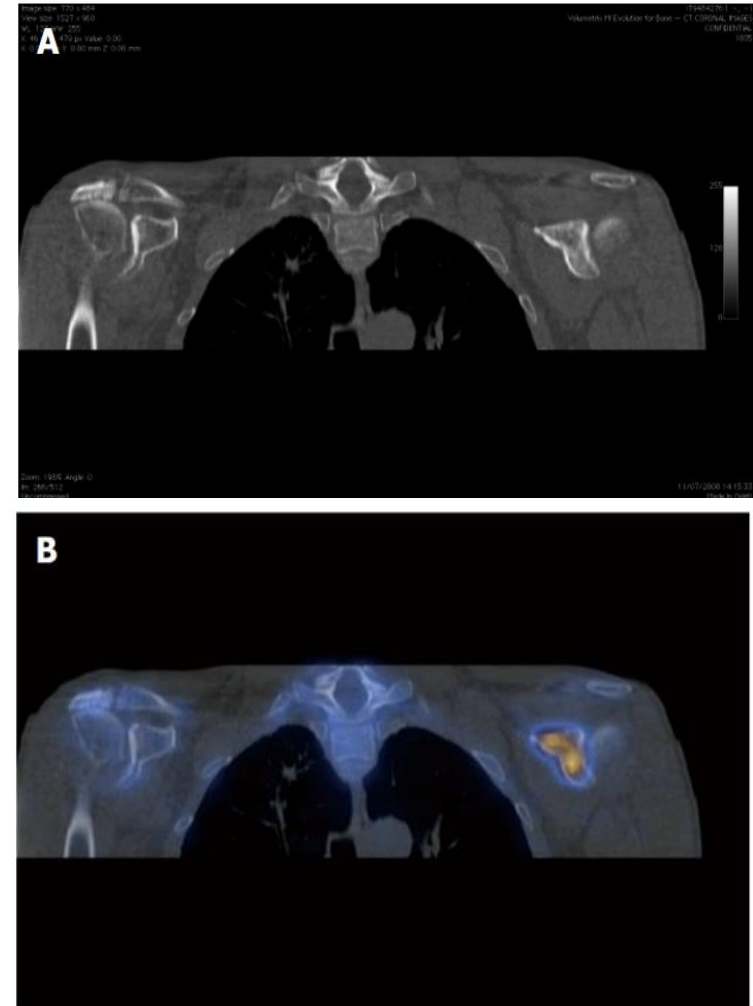
Ur Metser¹, Hedva Lerman, Annat Blank, Gennady Lievshitz, Felix Bokstein, Einat Even-Sapir



Review > World J Radiol. 2015 Aug 28;7(8):202-11. doi: 10.4329/wjr.v7.i8.202.

Imaging of bone metastasis: An update

Gerard J O'Sullivan¹, Fiona L Carty¹, Carmel G Cronin¹



Hipofracionamento de Meta Óssea

Definição medula RM vs mielografia

Comparative Study > World Neurosurg. 2019 Feb;122:e655-e666.

doi: 10.1016/j.wneu.2018.10.118. Epub 2018 Oct 26.

Computed Tomography Myelosimulation Versus Magnetic Resonance Imaging Registration to Delineate the Spinal Cord During Spine Stereotactic Radiosurgery

Whitney H Beeler¹, Kelly C Paradis¹, Joseph J Gemmete², Neeraj Chaudhary², Michelle M Kim¹, Sean R Smith³, Eric Paradis⁴, Martha M Matuszak¹, Paul Park⁴, Paul G Archer¹, Nicholas J Szerlip⁵, Daniel E Spratt¹

→ RM 3D T1 e T2

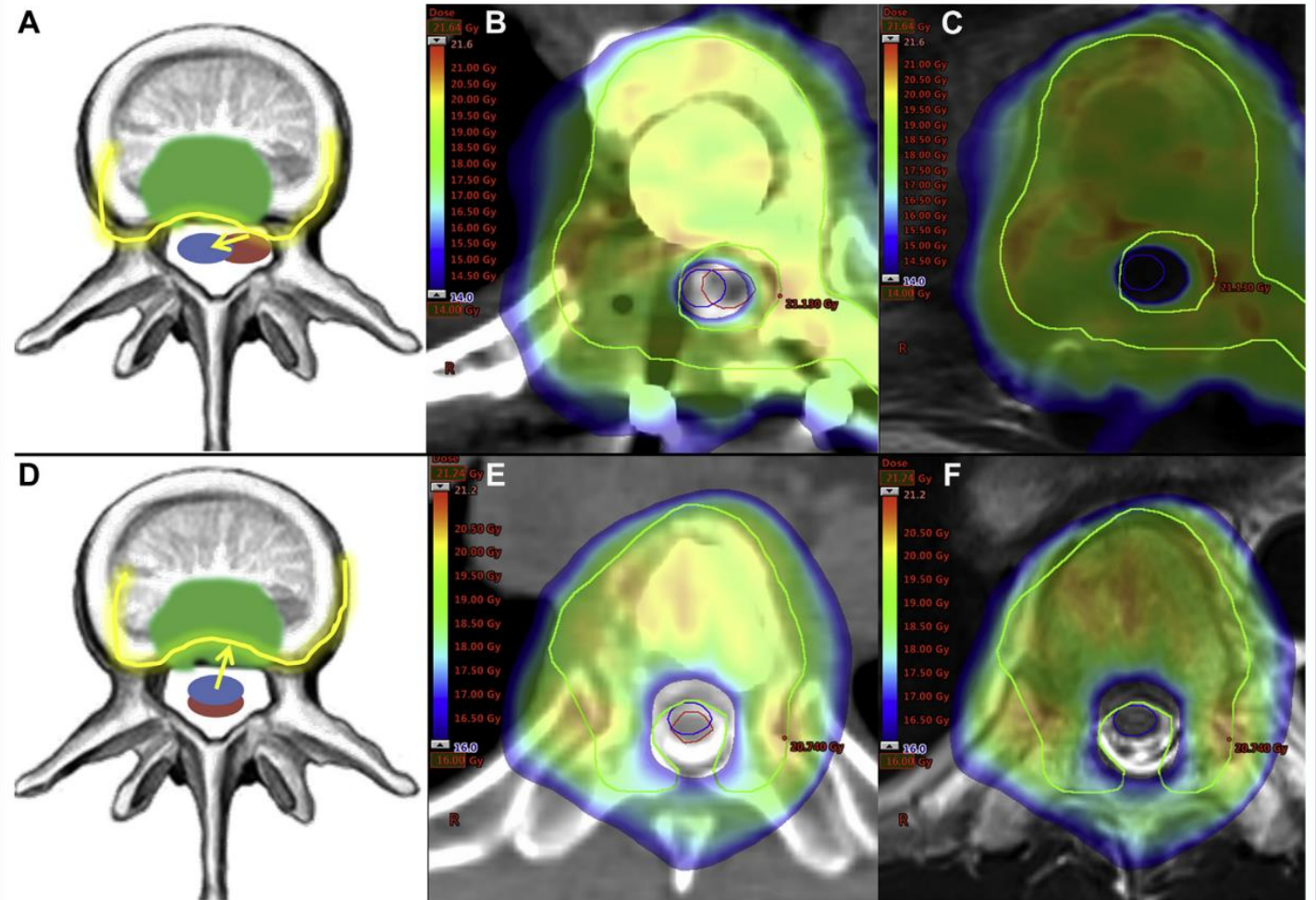


Figure 3. Theoretical pitfalls of magnetic resonance imaging (MRI) registration-based treatment planning. Spatial or volumetric discrepancies between the myelography during computed tomography simulation-defined spinal cord (red) and the MRI-defined spinal cord (blue)

can result in overdosing of the true spinal cord (A) or undercoverage of the tumor target volume (D). The 18-Gy MRI-based plans for case 1 (Bottom) and case 2 (Top) are examples of overdosing the spinal cord (B,C) and underdosing the planning target volume (green) (E,F).

Hipofracionamento de Meta Óssea

Imobilização para extremidades



Hipofracionamento de Meta Óssea

Pontos de atenção no hipofracionamento de metástases ósseas!

- CONFORTO = ESTABILIDADE no tratamento;
- Tratamentos rápidos minimizam chance de movimentação intra-fração;
- Imagens intra-fração são eficazes na verificação da estabilidade durante entrega de doses mais longas;
- Imagens multimodais (PET e RM) são importantes na definição de alvos e OARs.
 - Atenção na espessura de corte e qualidade da fusão entre imagens!!
- TCs com cortes de 1 a 2 mm são compatíveis com as dimensões dos alvos.

Hipofracionamento de Pulmão

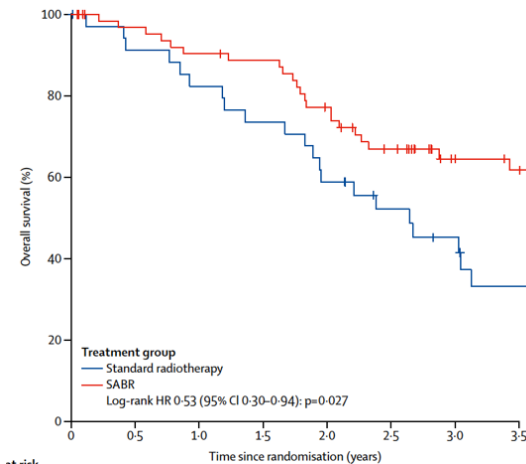
Hipofracionamento de pulmão - SBRT

Clinical Trial > Lancet Oncol. 2019 Apr;20(4):494-503. doi: 10.1016/S1470-2045(18)30896-9. Epub 2019 Feb 12.

Stereotactic ablative radiotherapy versus standard radiotherapy in stage 1 non-small-cell lung cancer (TROG 09.02 CHISEL): a phase 3, open-label, randomised controlled trial

David Ball ¹, G Tao Mai ², Shalini Vinod ³, Scott Babington ⁴, Jeremy Ruben ⁵, Tomas Kron ⁶, Brent Chesson ⁷, Alan Herschtal ⁸, Marijana Vanevski ⁸, Angela Rezo ⁹, Christine Elder ¹⁰, Marketa Skala ¹¹, Andrew Wirth ⁷, Greg Wheeler ⁷, Adeline Lim ¹², Mark Shaw ⁷, Penelope Schofield ¹³, Louis Irving ¹⁴, Benjamin Solomon ⁶, TROG 09.02 CHISEL investigators

Collaborators, Affiliations + expand
PMID: 30770291 DOI: 10.1016/S1470-2045(18)30896-9



Clinical Trial > J Clin Oncol. 2020 Sep 1;38(25):2830-2838. doi: 10.1200/JCO.20.00818. Epub 2020 Jun 2.

Stereotactic Ablative Radiotherapy for the Comprehensive Treatment of Oligometastatic Cancers: Long-Term Results of the SABR-COMET Phase II Randomized Trial

David A Palma ¹, Robert Olson ², Stephen Harrow ³, Stewart Gaede ¹, Alexander V Louie ⁴, Cornelis Haasbeek ⁵, Liam Mulroy ⁶, Michael Lock ¹, George B Rodrigues ¹, Brian P Yaremko ¹, Devin Schellenberg ⁷, Belal Ahmad ¹, Sashendra Senthil ⁸, Anand Swaminath ⁹, Neil Kopek ¹⁰, Mitchell Liu ¹¹, Karen Moore ³, Suzanne Currie ³, Roel Schlijper ², Glenn S Bauman ¹, Joanna Laba ¹, X Melody Qu ¹, Andrew Warner ¹, Suresh Senan ⁵

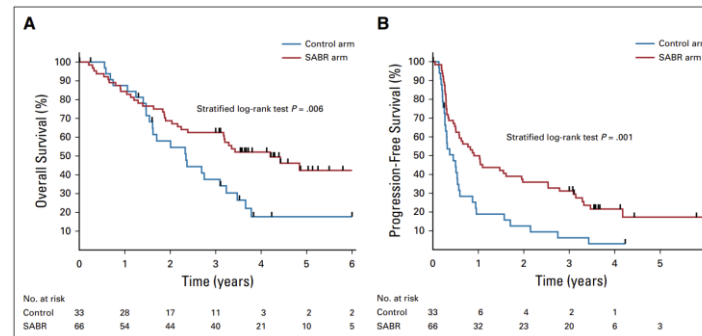


FIG 2. Kaplan-Meier plots for (A) overall survival and (B) progression-free survival. SABR, stereotactic ablative radiotherapy.

Curr. Treat. Options in Oncol.
DOI 10.1007/s11864-022-01002-x

Lung Cancer (TA Leal and N Sethakorn, Section Editors)

Role of Stereotactic Radiation Therapy in Operable and Inoperable Early-Stage Non-small Cell Lung Cancer

Lilian Faroni, MD, PhD^{1,*} 
Laura Collie, MD²
Flavia Gabrielli, MD¹
Clarissa Baldotto, MD, PhD¹
Fabio Moraes, MD, PhD²

Address

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Email: lifaroni@gmail.com

²Division of Radiation Oncology, Department of Oncology, Queen's University, Kingston, Canada

Hipofracionamento de pulmão - SBRT

> Radiother Oncol. 2012 Jul;104(1):28-32. doi: 10.1016/j.radonc.2012.03.020. Epub 2012 May 29.

An analysis of patient positioning during stereotactic lung radiotherapy performed without rigid external immobilization

Max Dahele ¹, Wilko Verbakel, Johan Cuijpers, Ben Slotman, Suresh Senan

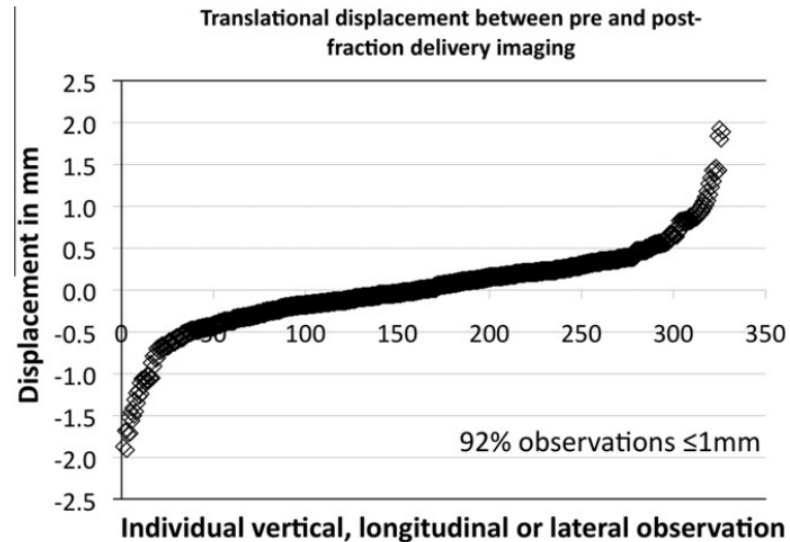


Fig. 1. Translational displacement of the spine as assessed with stereoscopic X-rays before and after the first and last arcs of stereotactic lung radiotherapy. Data presented in ascending order for 109 fractions. This resulted in 327 total observations made up of 109 pre and post-fraction comparisons in each of the three translational directions (lateral, longitudinal, vertical). 302/327 (92%) observations were $\leq \pm 1$ mm with 15/25 observations > 1 mm coming from 2 patients.



Conforto = Reprodutibilidade

Hipofracionamento de pulmão - SBRT

Randomized Controlled Trial > Radiother Oncol. 2010 Apr;95(1):103-8.

doi: 10.1016/j.radonc.2010.01.025. Epub 2010 Feb 26.

A comparison of two immobilization systems for stereotactic body radiation therapy of lung tumors

Kathy Han ¹, Patrick Cheung, Parminder S Basran, Ian Poon, Latifa Yeung, Fiona Lochray



Fig. 1. Bodyfix system (left) and the abdominal compression plate (right).

Setup time

The mean setup time required for the Bodyfix and the ACP was 40 ± 21 min and 33 ± 10 min, respectively. The ACP was significantly faster to set up than the Bodyfix ($p = 0.04$).

Patient comfort

Patients rated the ACP to be more comfortable than the Bodyfix (mean score of 3.2 vs 4.6, $p = 0.005$). The majority of patients (63%) preferred the ACP, 21% preferred the Bodyfix and 17% had no preference.

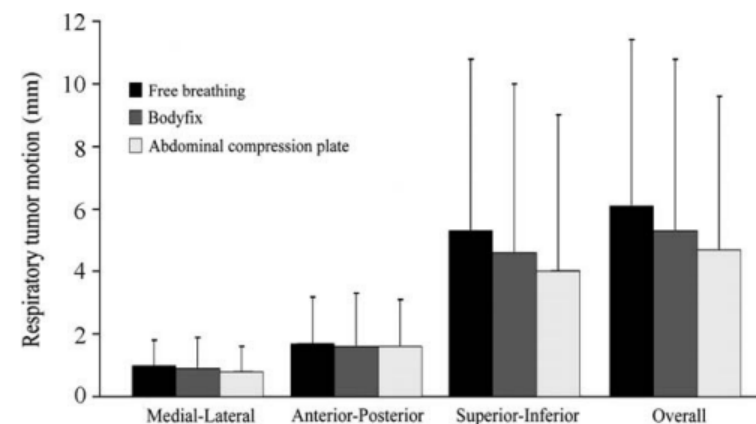


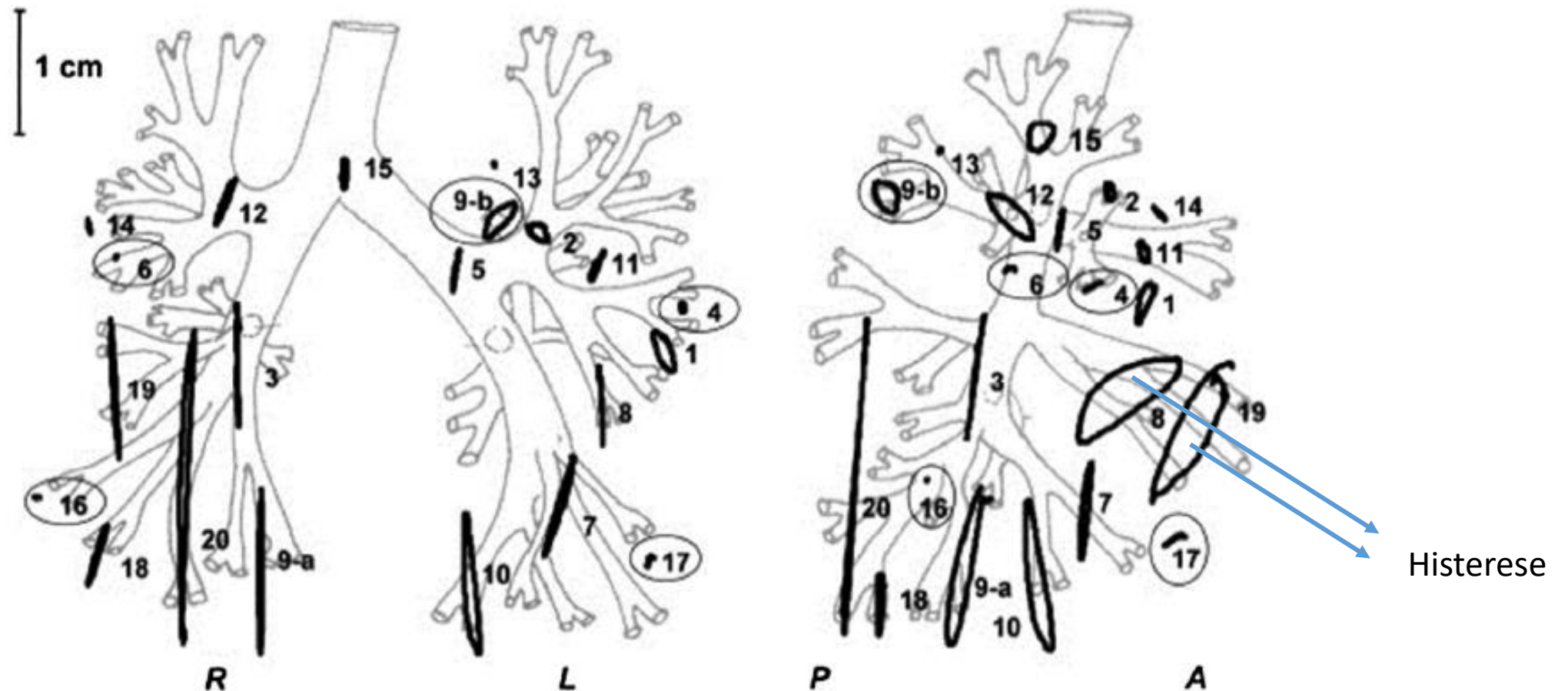
Fig. 3. Respiratory tumor motion with free breathing, the Bodyfix and the abdominal compression plate. Error bars represent one standard deviation.

Conclusion

Although there is no significant difference between the Bodyfix and ACP in reducing intrafraction tumor motion, the ACP is superior to the Bodyfix in terms of its efficacy in reducing SI and overall respiratory tumor motion, efficiency and comfort level. As such, the ACP may be the preferred method of immobilization for patients undergoing SBRT for lung tumors.

Hipofracionamento de pulmão - SBRT

Movimentação de 20 lesões analisadas com fiduciais



Hipofracionamento de pulmão - SBRT

Estudo da movimentação respiratória



4DCT



Definição de um ITV em AVG



TC em DIBH

Hipofracionamento de pulmão - SBRT

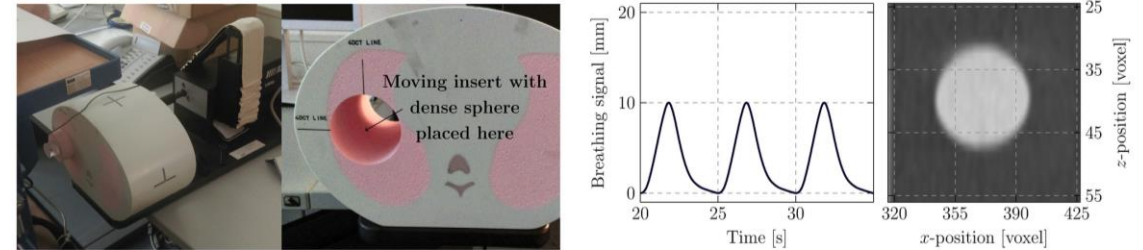
TC4Ds são altamente suscetíveis a artefatos

> Med Phys. 2019 Aug;46(8):3462-3474. doi: 10.1002/mp.13632. Epub 2019 Jun 23.

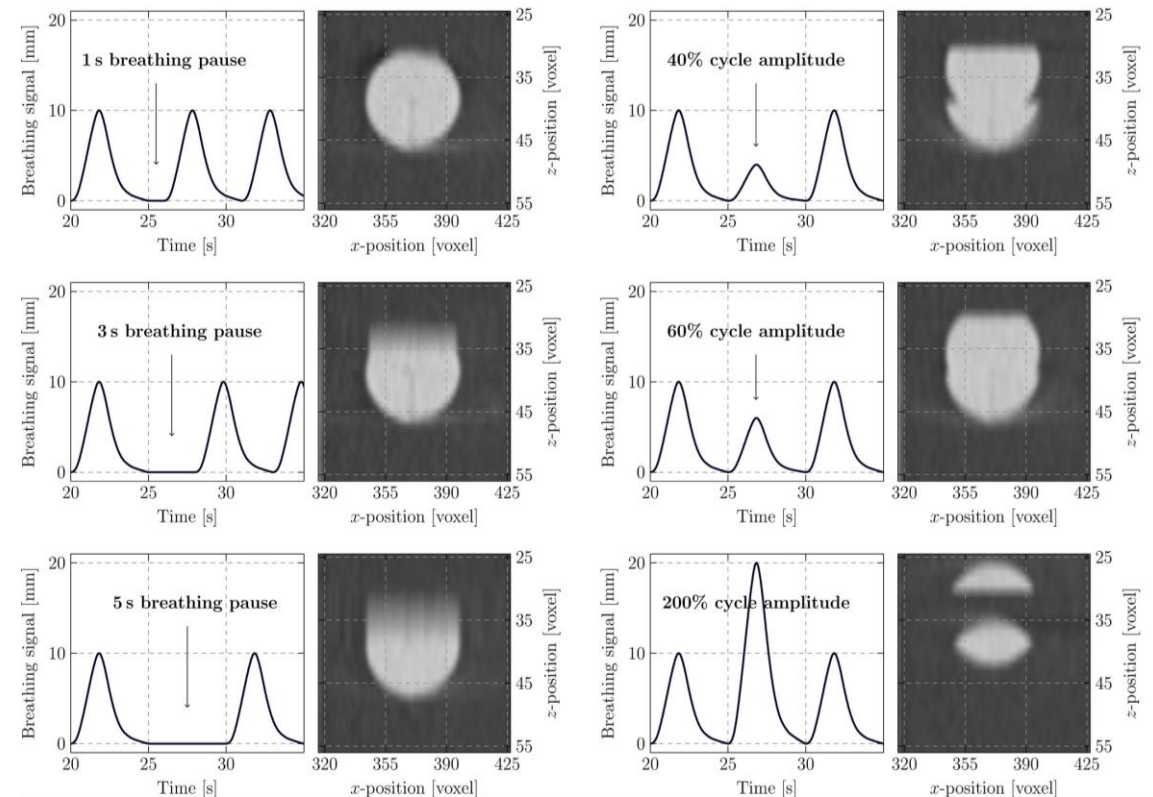
Intelligent 4D CT sequence scanning (i4DCT): Concept and performance evaluation

René Werner¹, Thilo Sentker^{1 2}, Frederic Madesta¹, Tobias Gauer², Christian Hofmann³

(b) CIRS phantom and reference geometry of spherical phantom insert



(c) Breathing irregularity at time of sphere scanning



Hipofracionamento de pulmão - SBRT

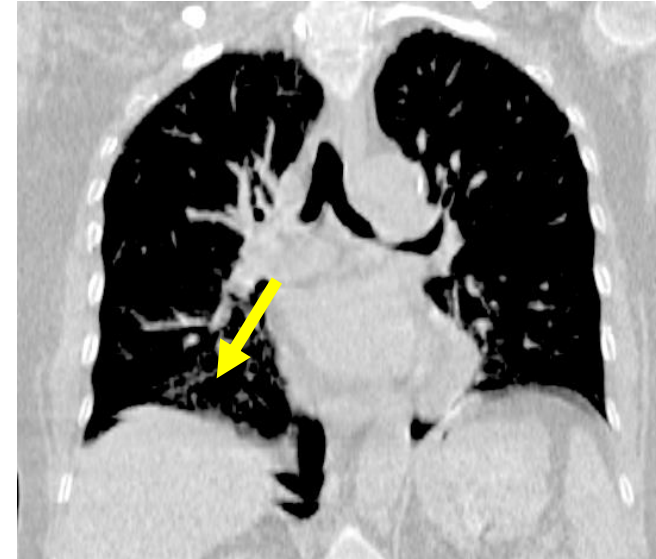
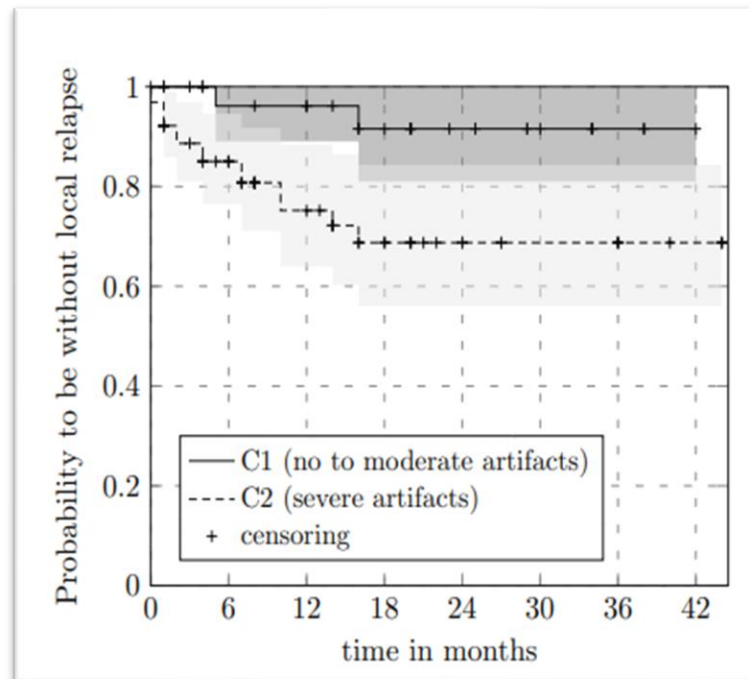
► *Radiother Oncol.* 2020 Jul;148:229-234. doi: 10.1016/j.radonc.2020.04.006. Epub 2020 Apr 9.

4D CT image artifacts affect local control in SBRT of lung and liver metastases

Thilo Sentker ¹, Vladimir Schmidt ², Ann-Kathrin Ozga ³, Cordula Petersen ², Frederic Madesta ⁴, Christian Hofmann ⁵, René Werner ⁴, Tobias Gauer ²

Affiliations + expand

PMID: 32442870 DOI: 10.1016/j.radonc.2020.04.006



Hipofracionamento de pulmão - SBRT

Considerações sobre a simulação em DIBH

A indicação correta é essencial:

- Tumores de base próximos ao diafragma;
- Idade <75 anos;
- Bom estado geral e capaz de entender o protocolo a ser realizado;

Durante a simulação:

- Explicar extensivamente o protocolo a ser realizado;
- Garantir que o paciente consegue realizar DIBH múltiplas vezes de maneira reprodutível;
- Garantir que a retenção de fôlego é estável;
- Garantir que o paciente é capaz de reter o fôlego por ao menos 30s;
- Adquirir a curva/padrão realizado para reprodução no tratamento.

Hipofracionamento de pulmão - SBRT

E se não tenho 4DCT ou Gating?

> Int J Radiat Oncol Biol Phys. 2004 Mar 15;58(4):1251-7. doi: 10.1016/j.ijrobp.2003.09.081.

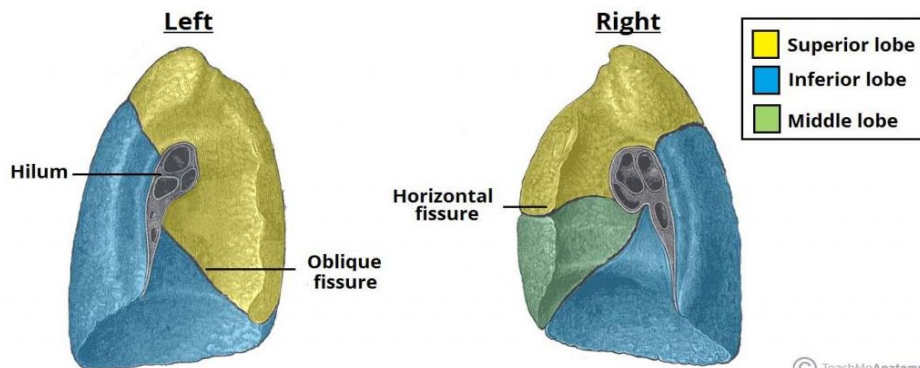
Evaluation of the influence of breathing on the movement and modeling of lung tumors

Aaron M Allen¹, Kristie M Siracuse, James A Hayman, James M Balter

Comparative Study > Int J Radiat Oncol Biol Phys. 2003 Apr 1;55(5):1394-9.
doi: 10.1016/s0360-3016(02)04602-3.

Are multiple CT scans required for planning curative radiotherapy in lung tumors of the lower lobe?

John R van Sörnsen de Koste¹, Frank J Lagerwaard, Hans C J de Boer, Margriet R J Nijssen-Visser, Suresh Senan



Fonte: <https://teachmeanatomy.info/thorax/organs/lungs/>

- Adquirir TCs durante a inspiração, expiração e livre para o contorno da lesão, e utilizar a TC livre para o planejamento.
- Utilizar uma aquisição lenta (pitch<0.1) para definição do caminho médio da lesão (o CBCT é uma aquisição média lenta!).
- Fiducial pode ser uma opção, embora taxas de complicação serem relativamente altas.
- RTOG 0813 e 0915 → margem GTV-PTV 0.5 cm radial e 1 cm no cranio-caudal caso não exista 4DCT.

Protocolos mais recentes demandam TC4D

Hipofracionamento de pulmão - SBRT

Pontos de atenção no hipofracionamento de pulmão!

- Um bom controle respiratório é essencial para 4DCT, minimizando artefatos de movimento e incertezas. Faça uso de sistemas audiovisuais se disponíveis;
- A técnica de DIBH deve ser reservada a pacientes com bom estado geral e capazes de entender e executar as instruções propostas. Teste a reprodutibilidade na retenção de fôlego;
- Caso 4DCT não esteja disponível, aquisições em insp e exp pode ser usadas para estimar o caminho médio da lesão. Margens conservadoras devem ser consideradas;
- O PET utilizado para o estadiamento pode ser utilizado no delineamento da lesão;
- TC com cortes de 2 mm são compatíveis com as dimensões dos alvos.

Hipofracionamento de Abdômen

Hipofracionamento de abdômen - SBRT

Fígado

Practice Guideline > Pract Radiat Oncol. 2022 Jan-Feb;12(1):28-51.

doi: 10.1016/j.prro.2021.09.004. Epub 2021 Oct 21.

External Beam Radiation Therapy for Primary Liver Cancers: An ASTRO Clinical Practice Guideline

Smith Apisarnthanarax ¹, Aisling Barry ², Minsong Cao ³, Brian Czito ⁴, Ronald DeMatteo ⁵, Mary Drinane ⁶, Christopher L Hallemeier ⁷, Eugene J Koay ⁸, Foster Lasley ⁹, Jeffrey Meyer ¹⁰, Dawn Owen ⁷, Jennifer Pursley ¹¹, Stephanie K Schaub ¹², Grace Smith ⁸, Neeta K Venepalli ¹³, Gazi Zibari ¹⁴, Higinia Cardenes ¹⁵

Table 6 Recommended EBRT doses and fractionation for HCC and IHC*

Fractionation Regimen	Total dose/fractionation	BED ₁₀	References
Ultrahypofractionation	Noncirrhotic (primarily IHC): 4000-6000 cGy/3-5 fx	7200-18,000 cGy	110
	CP class A: 4000-5000 cGy/3-5 fx	7200-12,500 cGy	24,27,28,30,34,43, 44,61,86,101,111
	CP class B7: 3000-4000 cGy/5 fx	4800-7200 cGy	28,36,86,94,101
	4000-5400 cGy/6 fx	6700-10,300 cGy	65,93
	5000-6600 cGy/10 fx	7500-11,000 cGy	57,59,83,90,100,112
Moderate hypofractionation	4800 cGy/12 fx	6720 cGy	110
	4500-6750 cGy/15 fx	5900-9800 cGy	42,46,50,62,90,113,114
	6000 cGy/20 fx	7800 cGy	57
	6600-7200 cGy/22 fx	8600-9600 cGy	57-59,112
Standard fractionation	5040 cGy/28 fx	5947 cGy	114,115
	6000 cGy/30 fx	7200 cGy	114,115
	7700 cGy/35 fx	9400 cGy	58,59

Abbreviations: BED₁₀ = biologically effective dose assuming an $\alpha/\beta = 10$; CP = Child-Pugh; EBRT = external beam radiation therapy; fx = fractions; HCC = hepatocellular carcinoma; IHC = intrahepatic cholangiocarcinoma.

* Bolded regimens are the most common prescriptions used, based on consensus of the task force. Dose constraints in Table 7 pertain to these most common dose fractionations.

† Lower doses recommended for central lesions in which the maximum point dose to central bile duct(s) cannot be met.

‡ For IHC when combined with concurrent systemic therapy.

45Gy@3fx
40-50Gy@5fx

Pâncreas

Review > J Gastrointest Oncol. 2016 Jun;7(3):479-86. doi: 10.21037/jgo.2015.10.01.

Stereotactic body radiotherapy for the pancreas: a critical review for the medical oncologist

Samuel K Kim ¹, Cheng-Chia Wu ¹, David P Horowitz ¹

Table 1 Study outcomes for pancreatic SBRT

Study	Number of patients	PDAC classification	Dose (Gy)	Number of fractions	Local control (1 year) (%)
Koong <i>et al.</i> , 2004	15	Locally advanced	15-25	1	100
Koong <i>et al.</i> , 2005	16	Locally advanced	25	1	94
Hoyer <i>et al.</i> , 2005	22	Locally advanced	45	3	57
Mahadevan <i>et al.</i> , 2010	36	Locally advanced	24-36	3	78
Schellenberg <i>et al.</i> , 2011	12	Locally advanced	25	1	94
Goyal <i>et al.</i> , 2012	20	Locally advanced	22-30	1-3	81
Lin <i>et al.</i> , 2015	20	Locally advanced	35-45	5	80
Moningi <i>et al.</i> , 2015	88	Borderline resectable and locally advanced	25-33	5	61

33-40Gy@5fx

Adrenal

Clinical Trial > Pract Radiat Oncol. 2017 May-Jun;7(3):e195-e203. doi: 10.1016/j.prro.2016.09.005.

Epub 2016 Sep 13.

Stereotactic ablative radiotherapy for adrenal gland metastases: Factors influencing outcomes, patterns of failure, and dosimetric thresholds for toxicity

William W Chance ¹, Quynh-Nhu Nguyen ¹, Reza Mehran ², James W Welsh ¹, Daniel R Gomez ¹, Peter Balter ³, Ritsuko Komaki ¹, Zhongxing Liao ¹, Joe Y Chang ⁴

Table 4. Use of hypofractionated stereotactic radiotherapy for adrenal metastases

Reference	No. of Patients	No. of Bilateral Lesions	NSCLC Primary	Median Follow-Up Time months	Median RT Dose /No. of Fractions	Median BED (a/b=10)	1-Yr Local Control	1-Yr Overall Survival	Median Overall Survival Time, months
Katoh <i>et al.</i> , 2008	9	1	56%	16	48/8	77	100%	78%	NR
Chawla <i>et al.</i> , 2009	30	5	67%	10	40/10	56	55%	44%	11
Torok <i>et al.</i> , 2011	7	2	57%	14	24/3	43	63%	NR	8
Holy <i>et al.</i> , 2011	18	0	100%	12	40/5	72	77% CC	NR	21
Oshiro <i>et al.</i> , 2011	19	0	74%	10	45/10	65	79% CC	56%	NR
Casamassima <i>et al.</i> , 2012	48	10	50%	16	36/3	79	90%	40%	NR
Guiou <i>et al.</i> , 2012	9	1	44%	7	25/5	38	44%	52%	10 (mean)
Scorsetti <i>et al.</i> , 2012	34	2	64%	41	32/4	58	66%	68%	23
Rudra <i>et al.</i> , 2013	10	3	60%	15	36/3	79	73%	90%	17
Ahmed <i>et al.</i> , 2013	13	0	38%	7	45/5	86	100% CC	63%	7
Li <i>et al.</i> , 2013	18	0	27%	NR	45/5	86	77% CC	62%	17
Desai <i>et al.</i> , 2015	11	0	43%	NR	25/3	47	64% CC	NR	NR
Chance <i>et al.</i> (current)	43	6	70%	16	60/10	96	74%	65%	19

30-45Gy@3fx

Hipofracionamento de abdômen - SBRT



AVG

Hipofracionamento de abdômen - SBRT



AVG



DIBH

Hipofracionamento de abdômen - SBRT

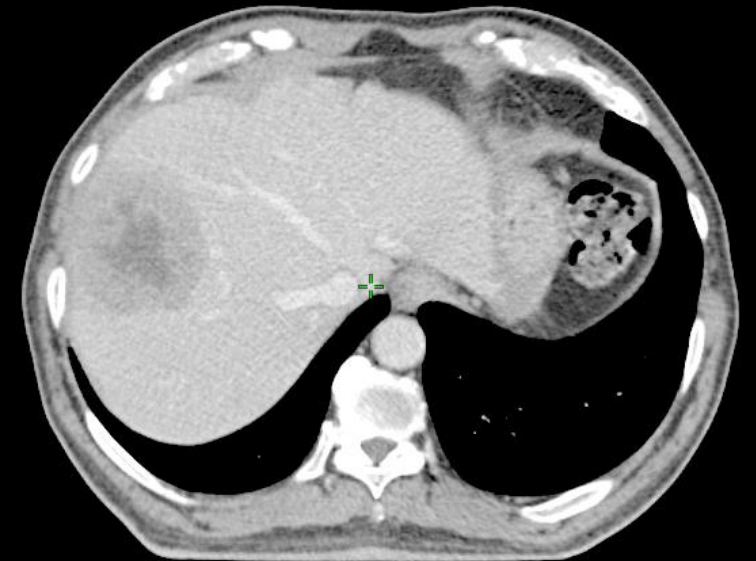
Uso de contraste venoso



SEM CONTRASTE

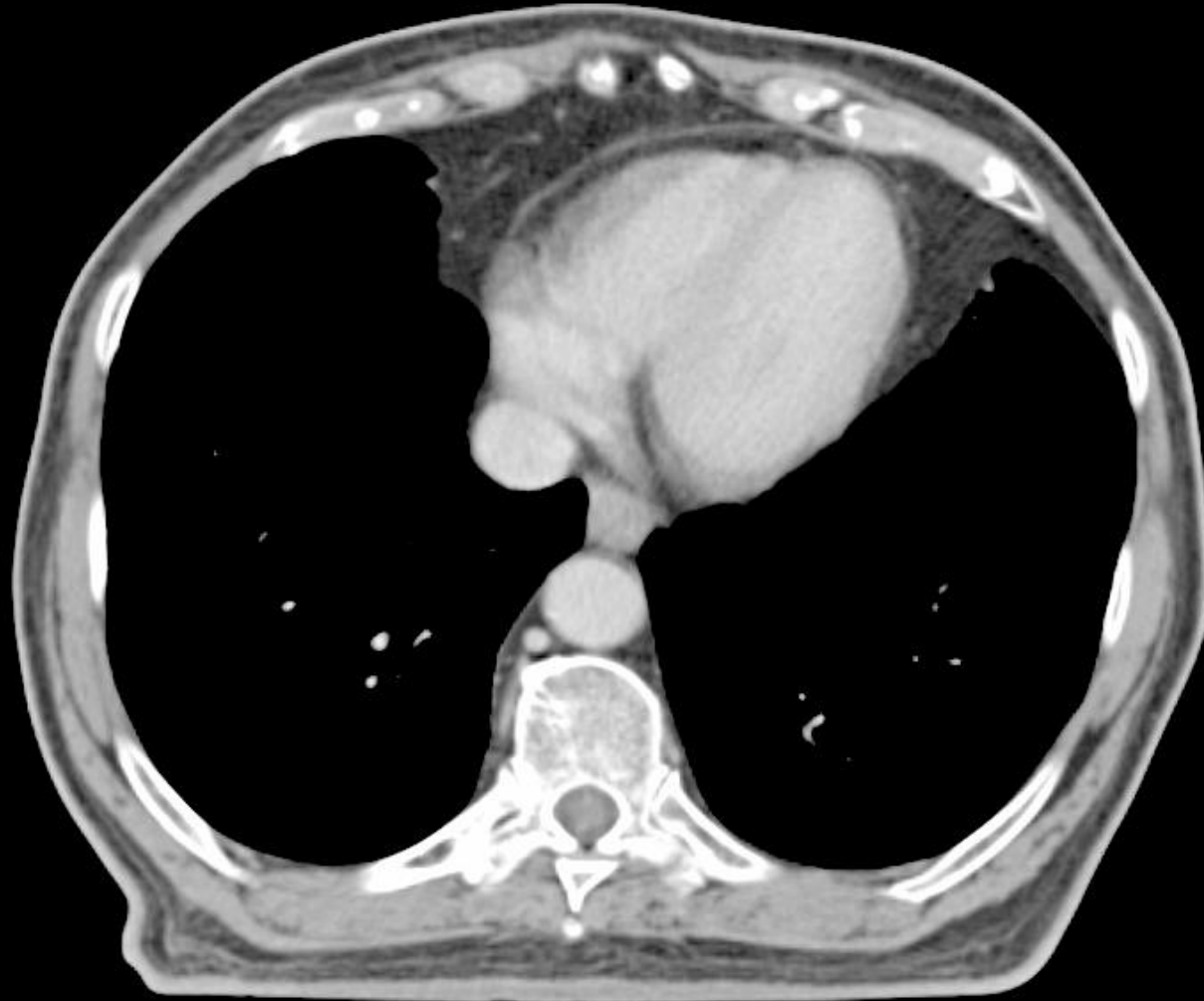


FASE ARTERIAL
(delay 35s)



FASE VENOSA
(delay 65s)

Hipofracionamento de abdômen - SBRT



TC DIBH – FASE VENOSA

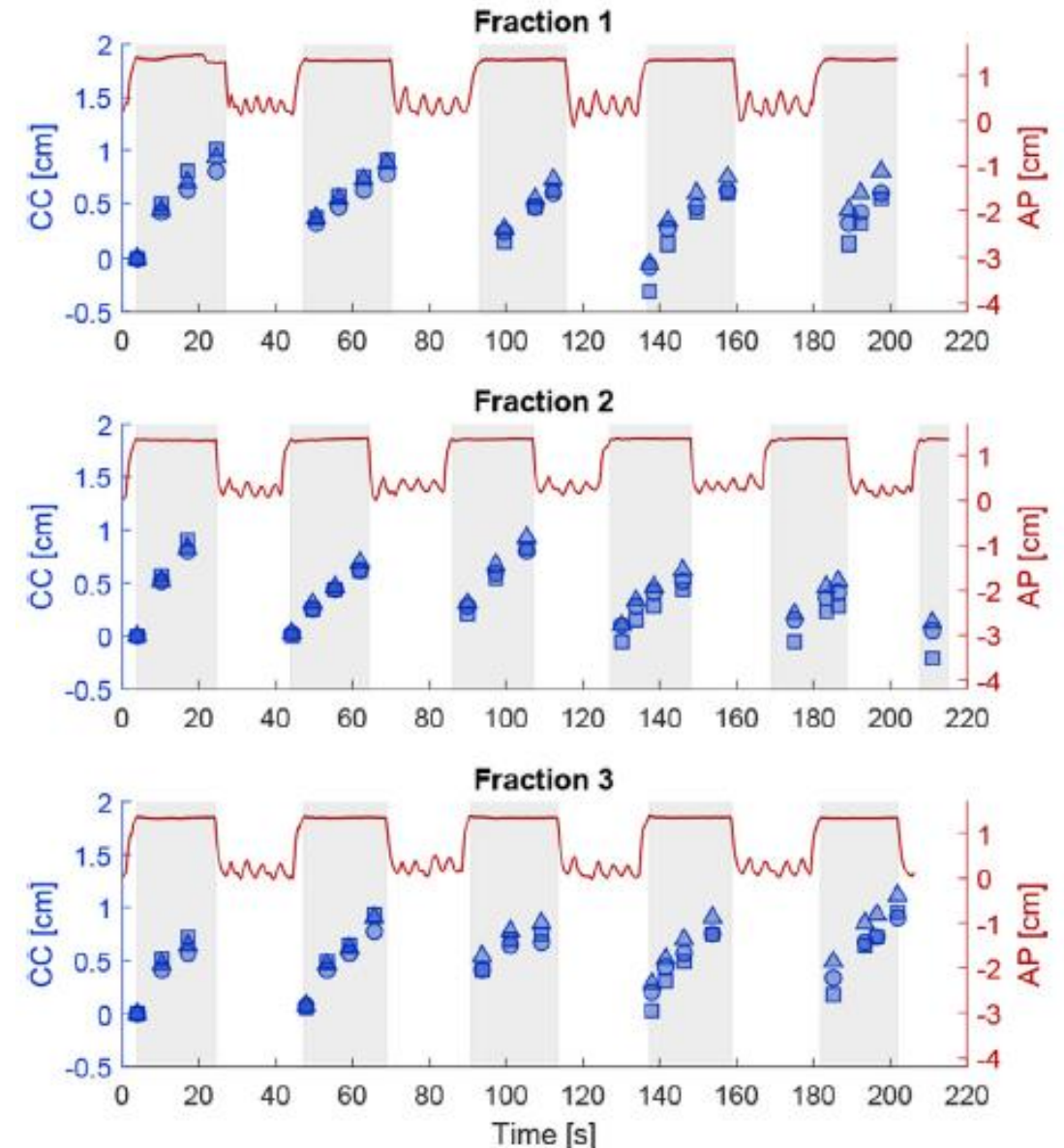
Hipofracionamento de abdômen - SBRT

> Br J Radiol. 2020 Dec 1;93(1116):20200859. doi: 10.1259/bjr.20200859. Epub 2020 Sep 11.

Intrafractional fiducial marker position variations in stereotactic liver radiotherapy during voluntary deep inspiration breath-hold

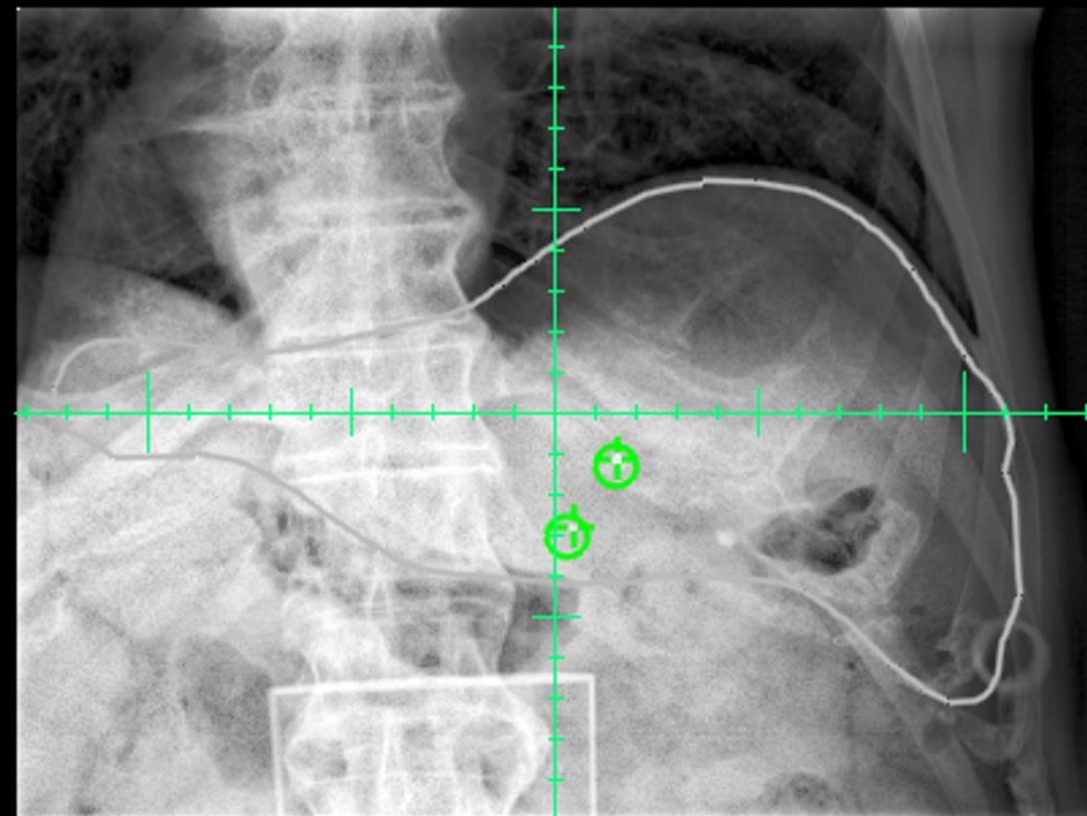
Line Bjerregaard Stick ^{1 2}, Ivan Richter Vogelius ^{1 3}, Signe Risum ¹, Mirjana Josipovic ¹

→Enfraquecimento da correlação entre marcador externo e alvo observada com uso de fiduciais.



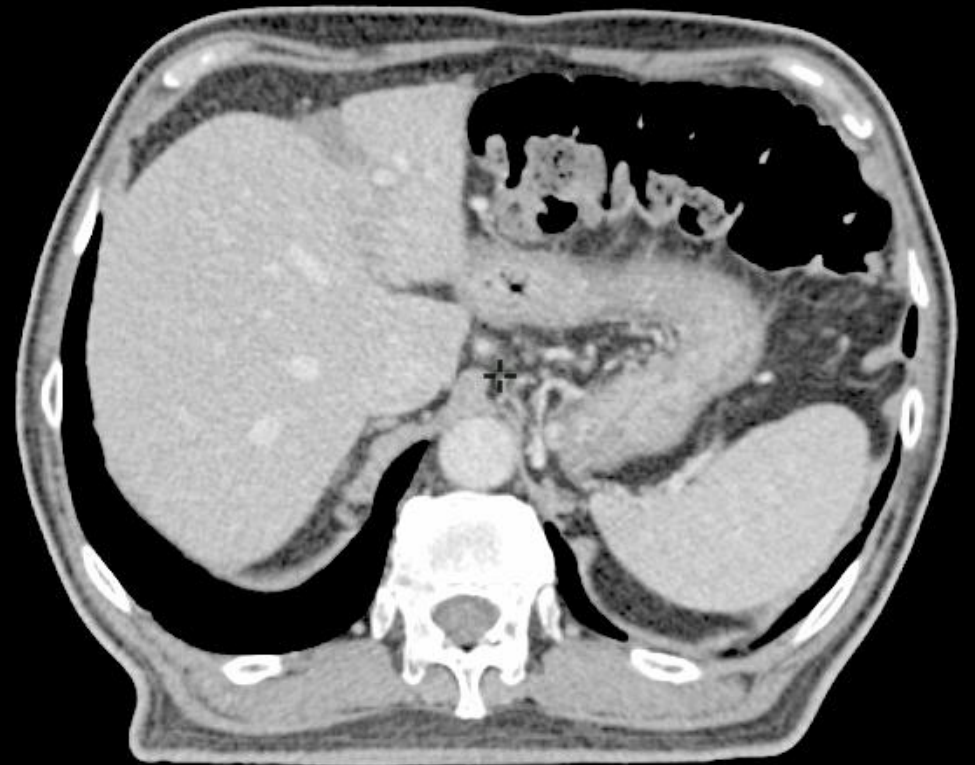
Hipofracionamento de abdômen - SBRT

Fiducial em fígado



Hipofracionamento de abdômen - SBRT

Cuidado com preparo de estômago e alças intestinais



Hipofracionamento de abdômen - SBRT

Pontos de atenção no hipofracionamento de abdômen!

- Paciente confortável e relaxado resulta em estabilidade no tratamento;
- Manejo respiratório similar ao pulmão é necessário;
- Estômago e alças intestinais são fontes adicionais de variabilidade!
- Imagens multimodais úteis no planejamento: PET/CT e RM;
- Utilização de contraste intravenoso na simulação pode auxiliar no delineamento do alvo;
- TC com cortes de 2 mm são compatíveis com as dimensões dos alvos.

Obrigado pela atenção,

Fim.

Setup e Imagens – Planejamentos para tratamentos hipofracionados: Quais os pontos de atenção?

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