HUMANITAS
CANCER CENTER

XXV CONGRESSO NAZIONALE
AIRO 2015
PALACONGRESSI - Rimini, 7-10 novembre

SIMPOSIO AIRO-AIFM
SBRT: Aggiornamenti clinici
e dosimetrici

Problematiche fisico dosimetriche della SBRT

GdL SBRT aifm

aifm
ASSOCIAZIONE ITALIANA DI FISICA MEDICA

pietro.mancosu@humanitas.it

DICHIARAZIONE

Relatore: Pietro Mancosu

Come da nuova regolamentazione della Commissione Nazionale per la Formazione Continua del Ministero della Salute, è richiesta la trasparenza delle fonti di finanziamento e dei rapporti con soggetti portatori di interessi commerciali in campo sanitario.

- Posizione di dipendente in aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
- Consulenza ad aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
- Fondi per la ricerca da aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
- Partecipazione ad Advisory Board **(NIENTE DA DICHIARARE)**
- Titolarietà di brevetti in compartecipazione ad aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
- Partecipazioni azionarie in aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
- Altro

Index

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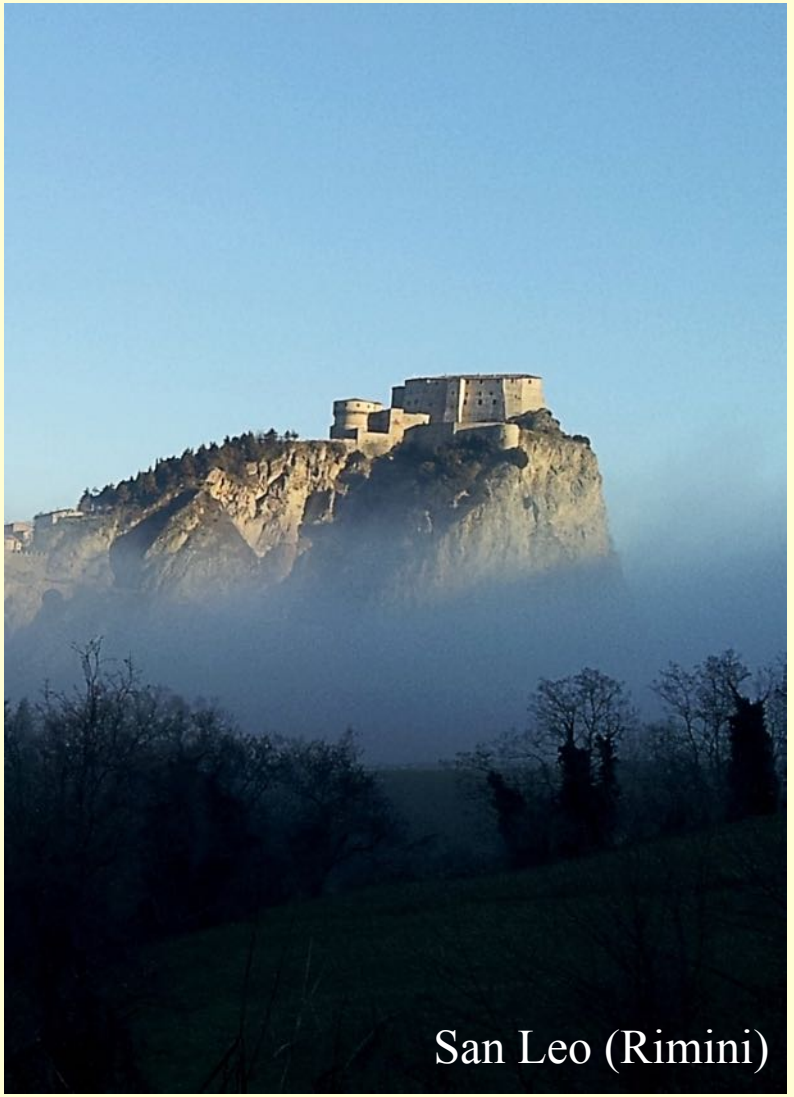
- Radiotherapy demand
- SBRT definition
- GdL AIFM
- Same Gray?
- Multiplanning experiences
- Small fields
- Take home message



San Leo (Rimini)

Radiotherapy demand

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JOURNAL OF CLINICAL ONCOLOGY

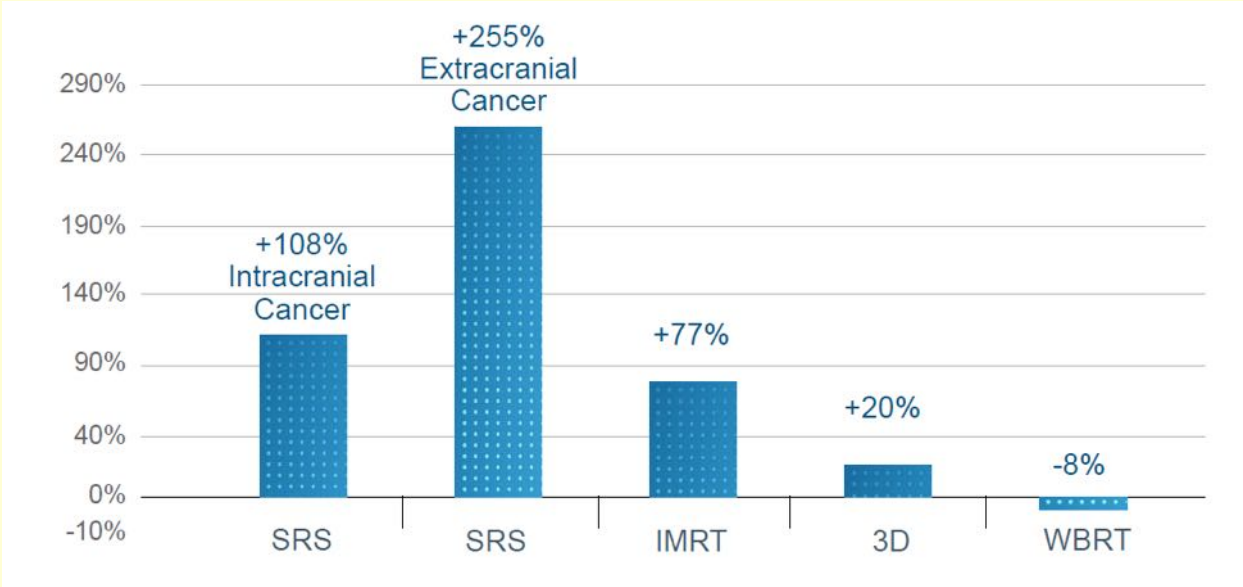
The Future of Radiation Oncology in the United States From 2010 to 2020: Will Supply Keep Pace With Demand?

Benjamin D. Smith, Bruce G. Haffty, Lynn D. Wilson, Grace L. Smith, Akshar N. Patel, and Thomas A. Buchholz

Table 1. Projected Estimates of Patients Receiving Radiation Therapy in 2010 and 2020

Tumor Site	No. of Patients Receiving Radiation Therapy		% Increase in Demand for Radiation Therapy From 2010 to 2020
	2010	2020	
Total	470,000	575,000	22

2014 → 2024



Source: SG2 Consulting, Skokle, Illinois, USA

SBRT for Lung Stage I

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THE LANCET Oncology

Treatment of early-stage lung cancer detected by screening: surgery or stereotactic ablative radiotherapy?

Lancet Oncol 2013; 14: e270–74

Suresh Senan, Marinus A Paul, Frank J Lagerwaard

Panel: Key considerations in local treatment decisions

Surgery

Pros:

- Definitive pathological diagnosis
- Enables invasive nodal staging in all cases
- Appropriate delivery of adjuvant therapy in node-positive disease

Cons:

- Procedure-related morbidity and mortality
- Invasive procedure for possibly benign disease

SABR

Pros:

- 5-year local disease control rates of more than 90%
- Outpatient procedure with mild acute toxicity
- Preservation of lung function and quality of life

Cons:

- Treatment without definite pathological verification
- Post-treatment fibrosis masking local disease recurrence

Randomize trial?

Correspondence

Quality assurance is a key component of stereotactic ablative radiotherapy, as it is with surgery. Multi-institutional trials and systematic reviews suggest that outcomes with SABR are generally consistent across several centres.[3] By contrast, results of hospital-volume studies suggest that surgical mortality data do not generalise well to smaller centres.[4]

Surgery versus SABR for NSCLC

In Paul Van Schil and Jan Van Meerbeeck's recent Correspondence,[1] the authors debate the merits of a Review[2] that forms the premise for randomised trials comparing surgery with stereotactic ablative radiotherapy (SABR) for early stage lung cancers detected by CT screening. They state that such trials are only warranted in patients with a compromised pulmonary or cardiac function who have an increased operative risk. However, we believe this comment does not reflect the evidence.

SBRT for prostate

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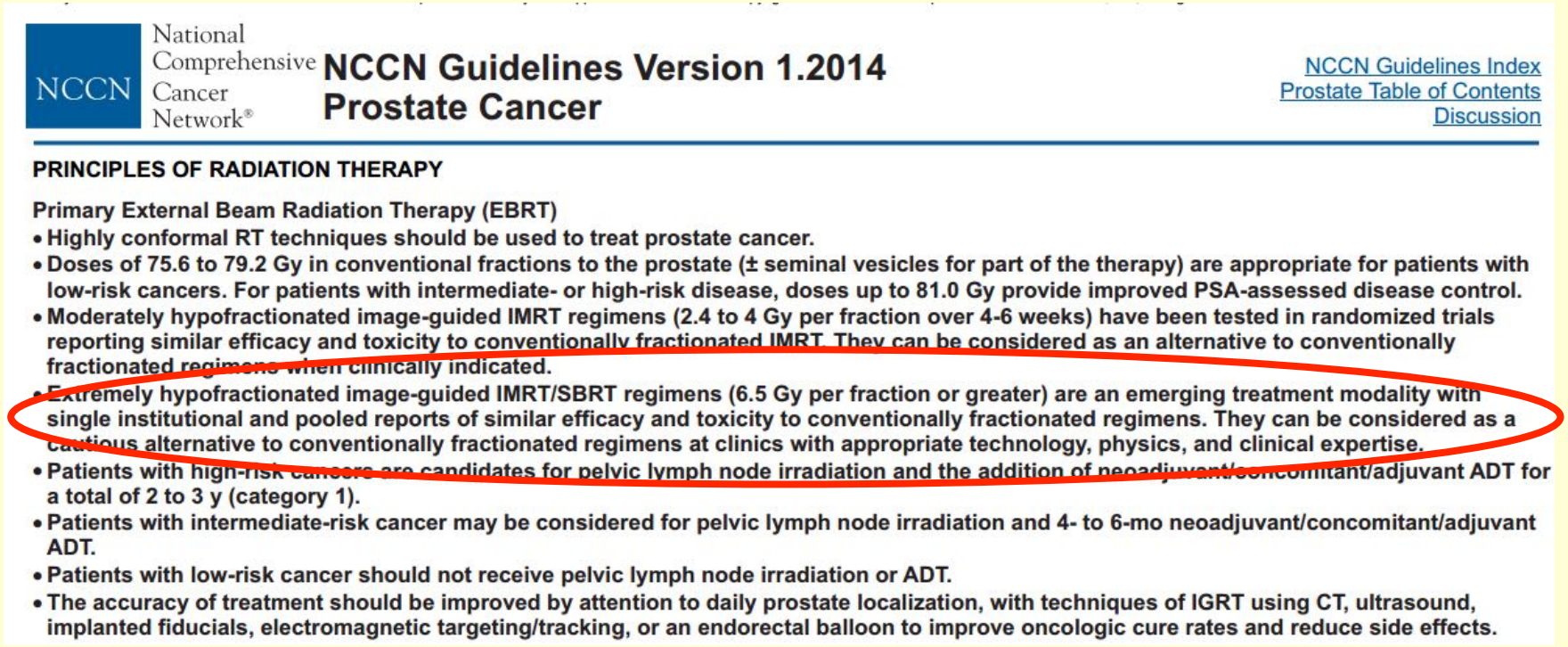

National Comprehensive Cancer Network®

NCCN Guidelines Version 1.2014
Prostate Cancer

NCCN Guidelines Index
Prostate Table of Contents
Discussion

PRINCIPLES OF RADIATION THERAPY

Primary External Beam Radiation Therapy (EBRT)

- Highly conformal RT techniques should be used to treat prostate cancer.
- Doses of 75.6 to 79.2 Gy in conventional fractions to the prostate (± seminal vesicles for part of the therapy) are appropriate for patients with low-risk cancers. For patients with intermediate- or high-risk disease, doses up to 81.0 Gy provide improved PSA-assessed disease control.
- Moderately hypofractionated image-guided IMRT regimens (2.4 to 4 Gy per fraction over 4-6 weeks) have been tested in randomized trials reporting similar efficacy and toxicity to conventionally fractionated IMRT. They can be considered as an alternative to conventionally fractionated regimens when clinically indicated.
- Extremely hypofractionated image-guided IMRT/SBRT regimens (6.5 Gy per fraction or greater) are an emerging treatment modality with single institutional and pooled reports of similar efficacy and toxicity to conventionally fractionated regimens. They can be considered as a cautious alternative to conventionally fractionated regimens at clinics with appropriate technology, physics, and clinical expertise.
- Patients with high-risk cancers are candidates for pelvic lymph node irradiation and the addition of neoadjuvant/concomitant/adjuvant ADT for a total of 2 to 3 y (category 1).
- Patients with intermediate-risk cancer may be considered for pelvic lymph node irradiation and 4- to 6-mo neoadjuvant/concomitant/adjuvant ADT.
- Patients with low-risk cancer should not receive pelvic lymph node irradiation or ADT.
- The accuracy of treatment should be improved by attention to daily prostate localization, with techniques of IGRT using CT, ultrasound, implanted fiducials, electromagnetic targeting/tracking, or an endorectal balloon to improve oncologic cure rates and reduce side effects.

Extremely hypofractionated IGRT/IMRT regiments (**6.5Gy** or greater) […] can be considered as a **cautious alternative** to conventionally fractionated regiments **at clinics with appropriate technology, physics and clinical expertise**.

Introduction: definitions SBRT

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

Stanley H. Benedict, Chairman[a)]
University of Virginia Health System, Charlottesville, Virginia 22908

REPORT

AMERICAN SOCIETY FOR THERAPEUTIC RADIOLOGY AND ONCOLOGY (ASTRO) AND AMERICAN COLLEGE OF RADIOLOGY (ACR) PRACTICE GUIDELINE FOR THE PERFORMANCE OF STEREOTACTIC BODY RADIATION THERAPY

high dose of radiation

compensate for target movements

single or a few fractions

non invasive

steep dose gradients

delivery precision

Small target

high targeting accuracy

team of skilled health care professionals

Italy of the towers

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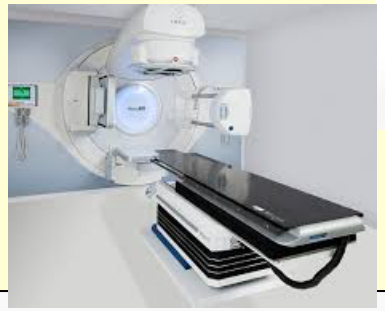
San Giminiano
1300 d.C.
72 towers
2000 abitants

UNESCO



GdL AIFM

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Aspetti fisico dosimetrici e radiobiologici della radioterapia ablativa ipofrazionata ad alte dosi guidata dalle immagini

107 aderenti

2013-2015

Objective 1:	Sharing of personal knowledge
Objective 2:	Multicentre studies
Objective 3:	Write common documents
Objective 4:	Seminars and schools

GdL SBRT aifm

Technical reviews on SBRT prostate

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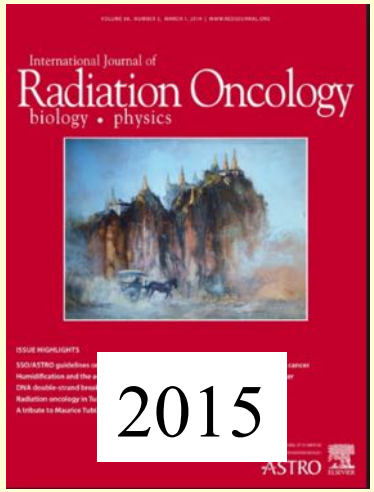
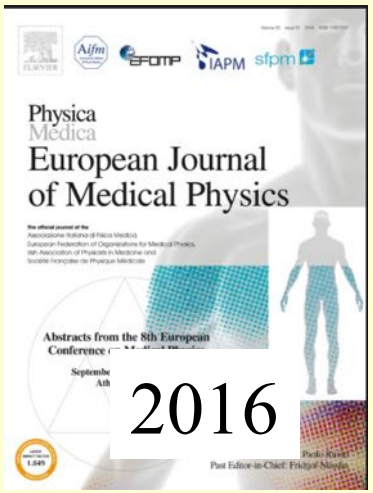


Role of the Technical Aspects of Hypofractionated Radiation Therapy Treatment of Prostate Cancer: A Review

Stefania Clemente, PhD,* Roberta Nigro, PhD,† Caterina Oliviero, PhD,* Chiara Marchioni, PhD,† Marco Esposito, PhD,‡ Francesca Romana Giglioli, PhD,§ Pietro Mancosu, PhD,|| Carmelo Marino, PhD,¶ Serenella Russo, PhD,‡ Michele Stasi, PhD,# Lidia Strigari, PhD,** Ivan Veronese, PhD,†† and Valeria Landoni, PhD**



SBRT for prostate cancer: challenges and risks from a physicist prospective

Pietro Mancosu, Stefania Clemente, Valeria landoni, Ruggero Ruggieri Michele Stasi

Do we have the same Gray?

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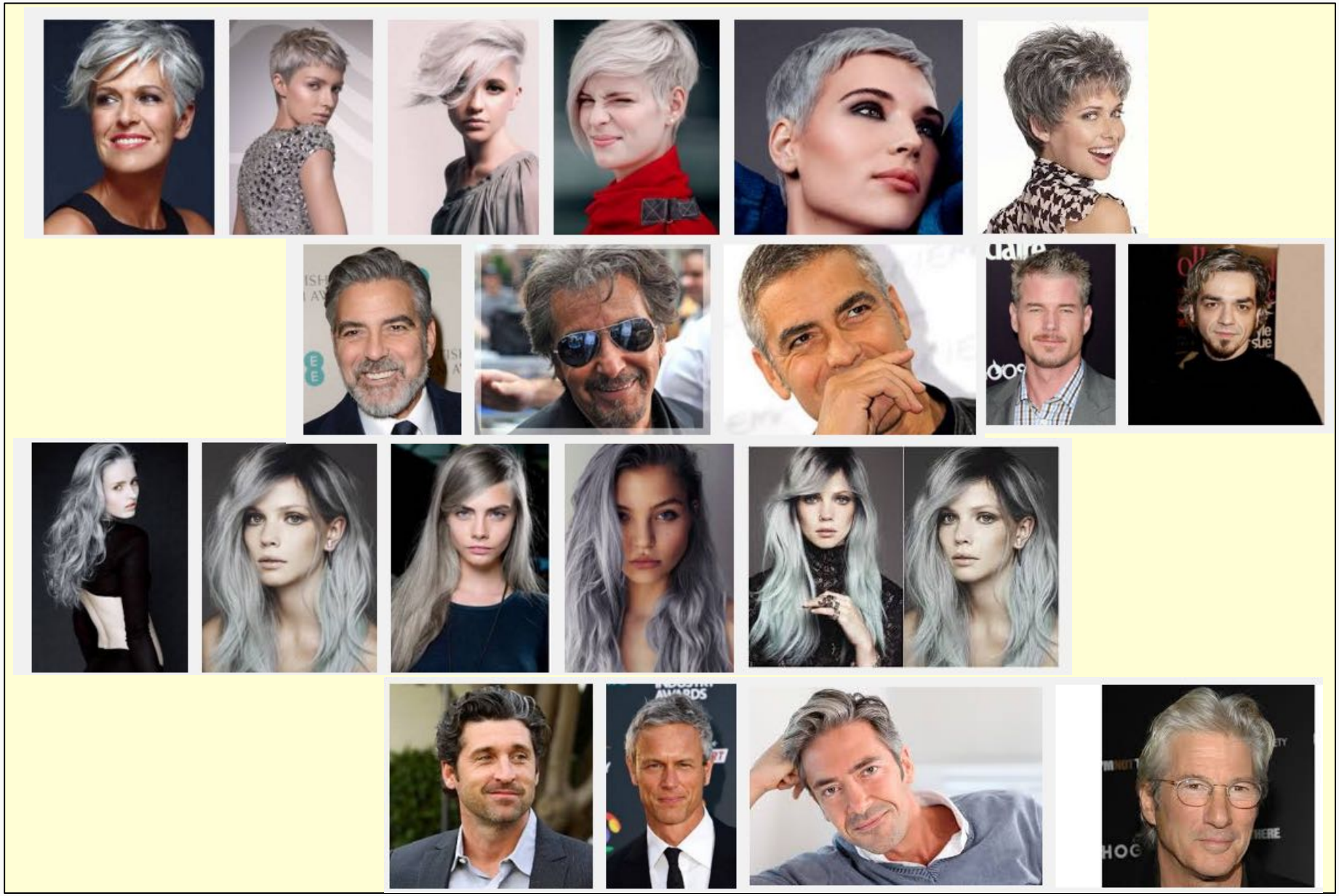


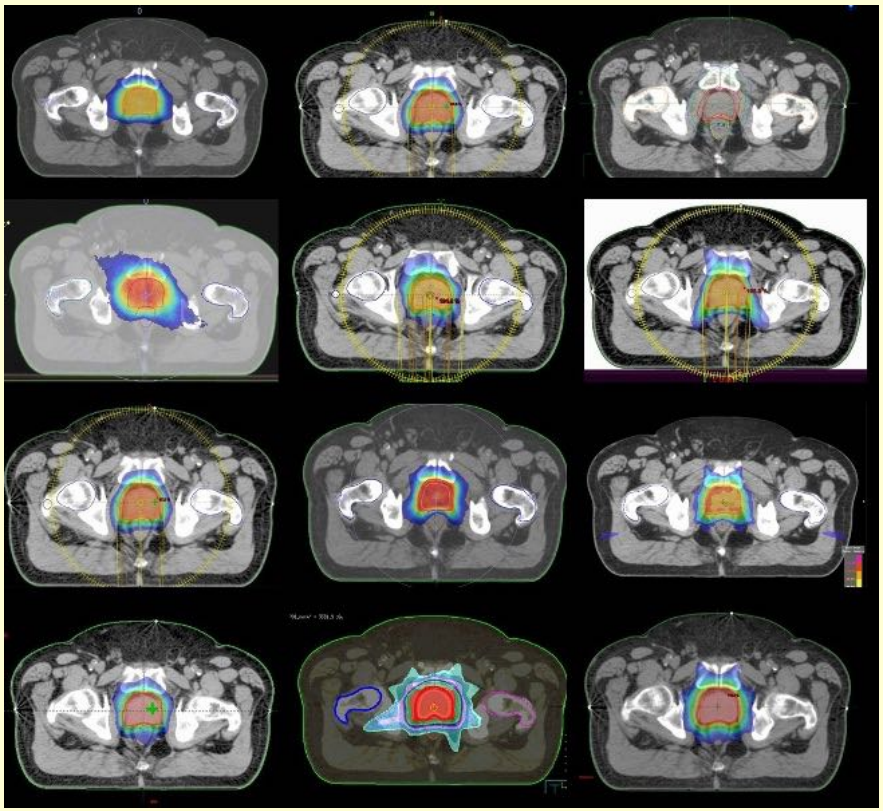
Multicenter planning: prostate

HUMANITAS CANCER CENTER

A feasibility dosimetric study on prostate cancer

Are we ready for a multicenter clinical trial on SBRT?

Carmelo Marino · Elena Villaggi · Giulia Maggi · Marco Esposito · Lidia Strigari · Elisa Bonanno · Giusi R. Borzì · Claudia Carbonini · Rita Consorti · David Fedele · Christian Fiandra · Isidora Ielo · Tiziana Malatesta · Maria Rosa Malisan · Anna Martinotti · Renzo Moretti · Barbara Nardiello · Caterina Oliviero · Stefania Clemente · Pietro Mancosu



14 centers
5 prostate cases
Same contours
Common protocol
35 Gy – 7Gy x 5 fr

Multicenter planning: prostate

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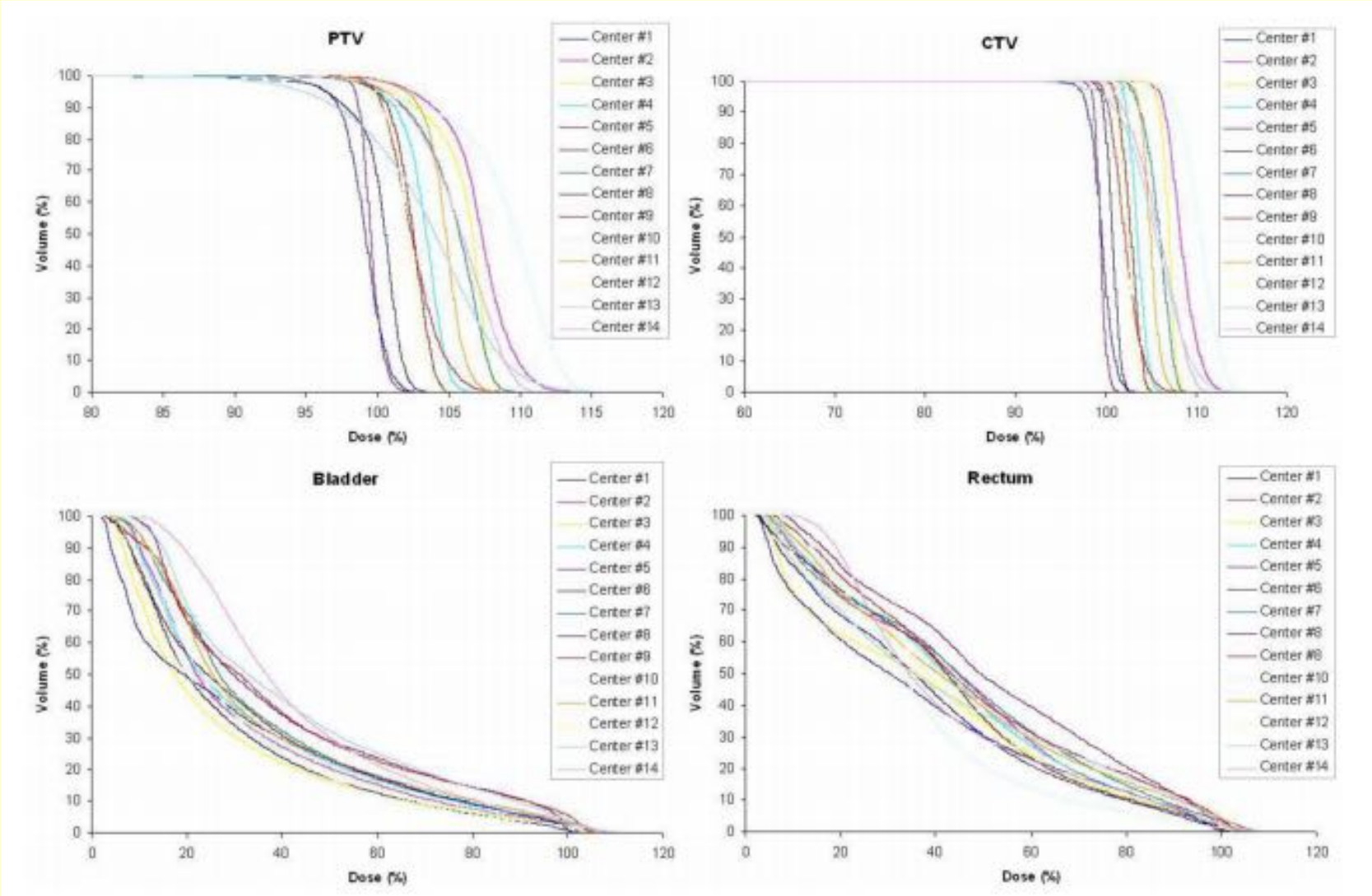

Mean DVH values over the 5 patients for the 14 centers

Multicenter planning: prostate

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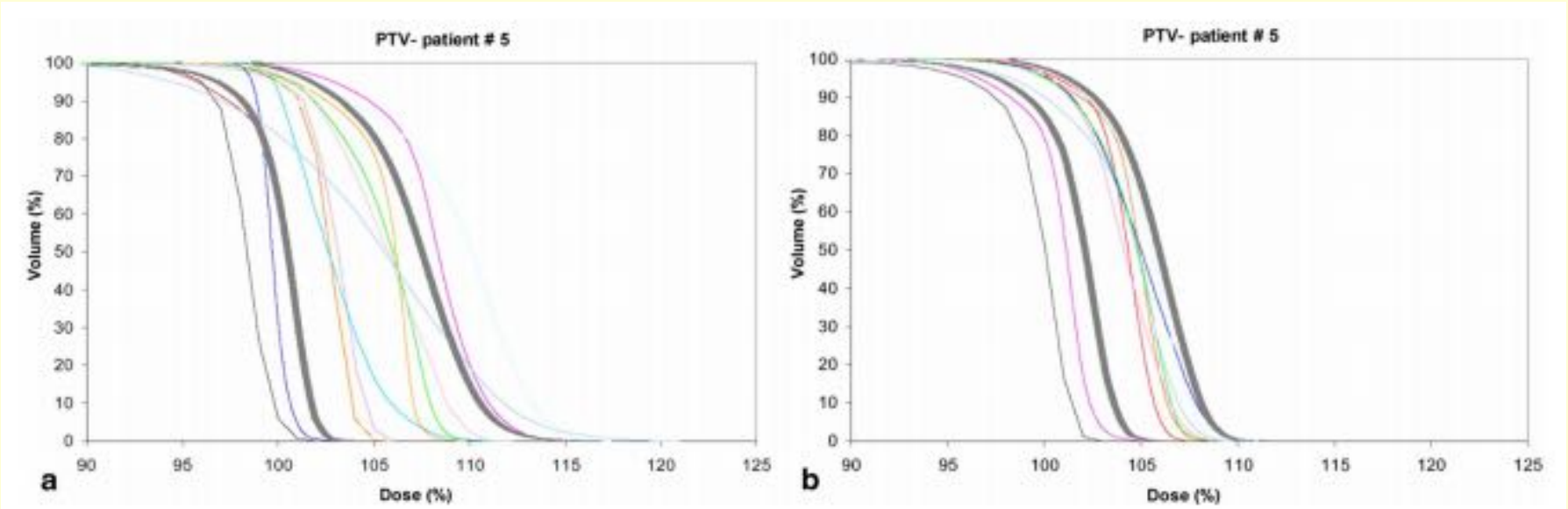

Fig. 4 Planning target volume DVH for prostate patient 5 for **a** the first optimization and **b** the second optimization

Replanned based on the mean values

Multicenter planning: liver

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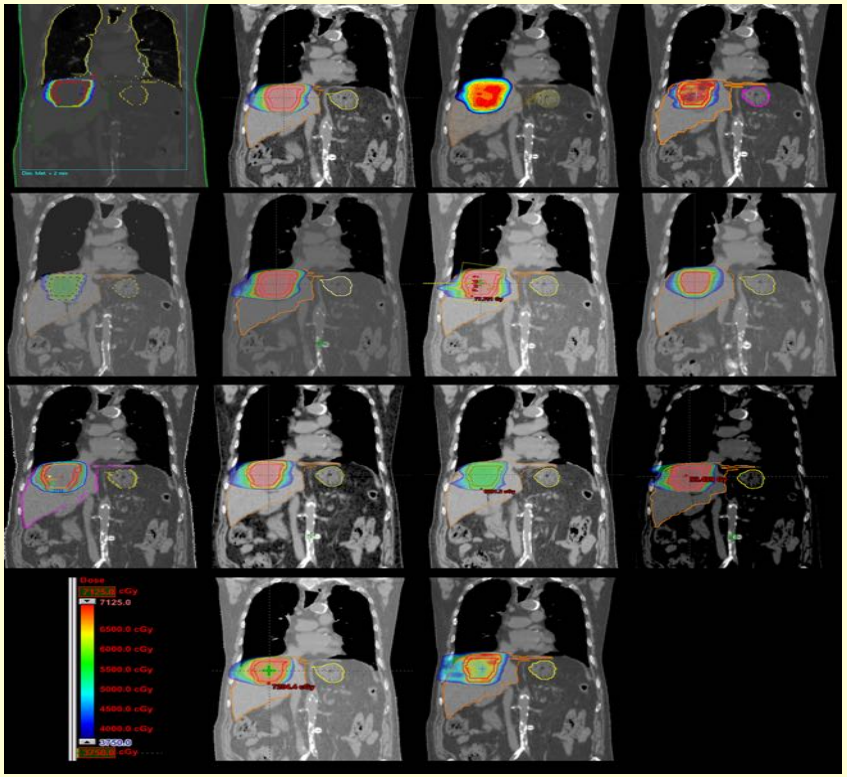
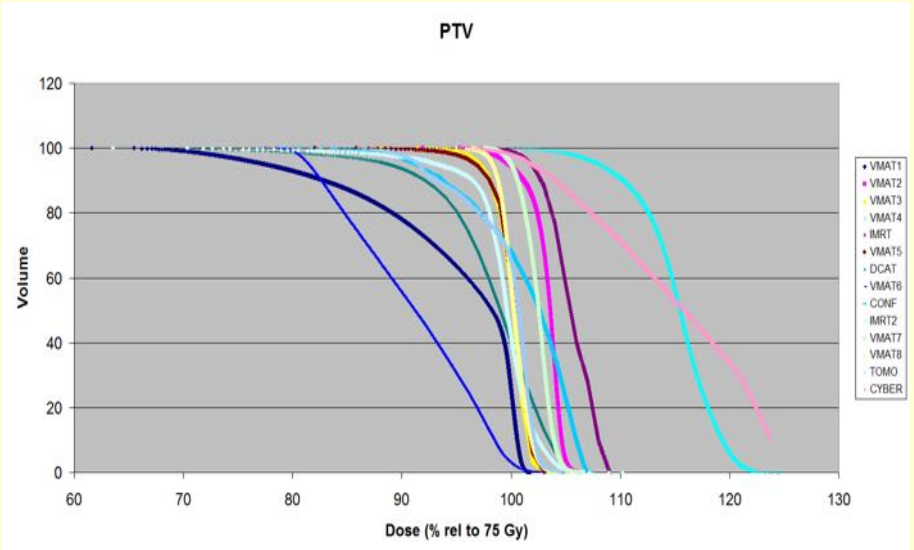
Multicentre treatment planning inter-comparison in a national context: The liver stereotactic ablative radiotherapy case

Marco Esposito [a], Giulia Maggi [b], Carmelo Marino [c], Laura Bottalico [d], Elisabetta Cagni [e], Claudia Carbonini [f], Michelina Casale [g], Stefania Clemente [h], Valentina D'Alesio [d], David Fedele [i], Francesca Romana Giglioli [j], Valeria Landoni [k], Anna Martinotti [l], Roberta Nigro [m], Lidia Strigari [k,*], Elena Villaggi [n], Pietro Mancosu [b]



12 centers; 5 liver cases
Common protocol
75 Gy – 25Gy x 3 fr
V95%>95% (at least 67%)



To be or not to be homogeneous?

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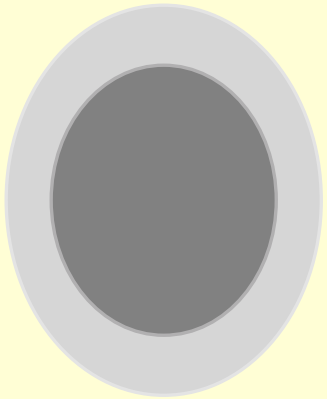
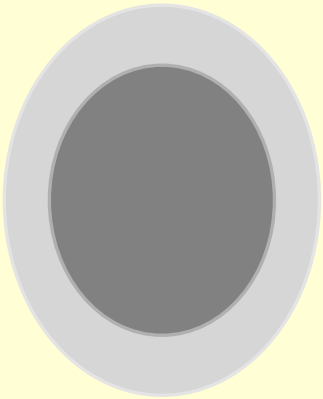
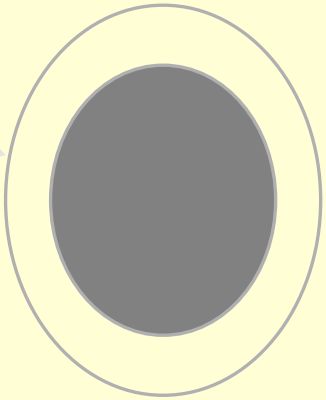
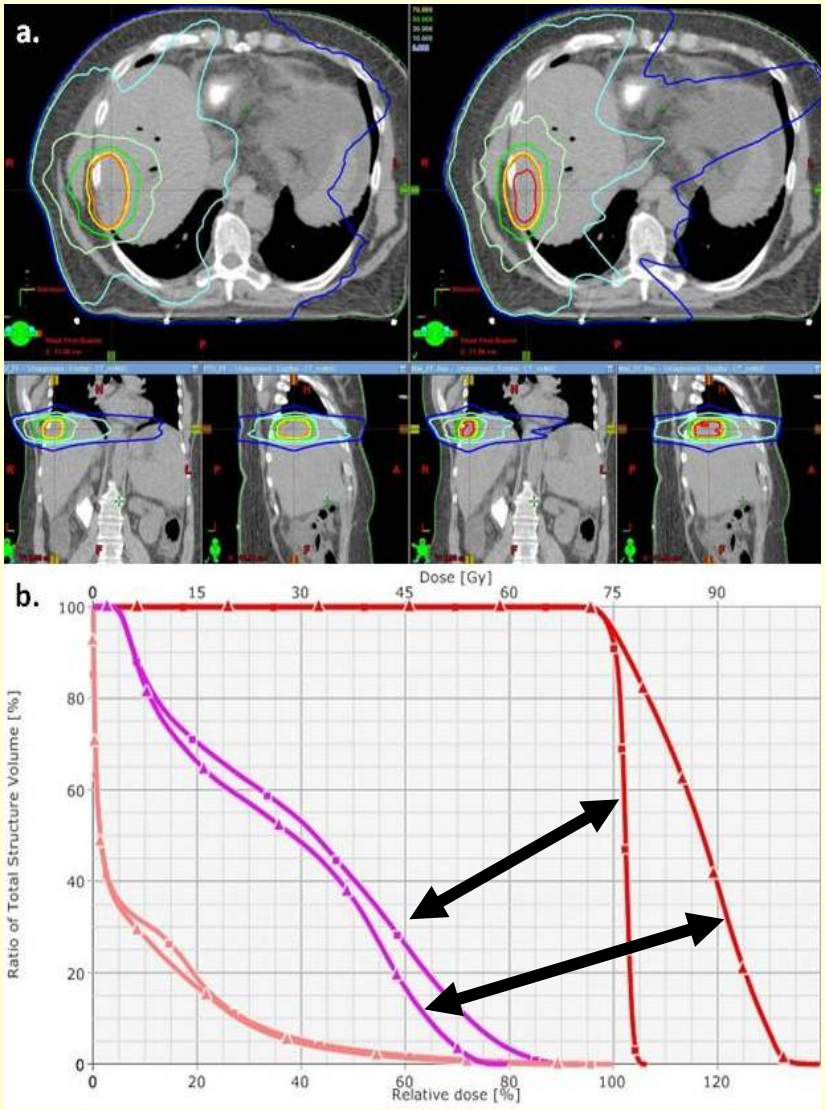
ICRU 83	AAPM report 101	GammaKnife style
50 Gy prescribed to mean PTV volume	50 Gy prescribed to periphery PTV (80%)	50 Gy prescribed to periphery CTV (50%)
		PTV? 
PTV and CTV D_{max} = 53-55Gy D_{mean} = 50 Gy D_{min} = 47.5-48Gy HI = 7-10%	PTV and CTV D_{max} = 62.5 Gy D_{mean} = 54-57 Gy D_{min} = 50 Gy HI = 20%	CTV D_{max} = 100 Gy D_{mean} = 70-80 Gy D_{min} = 50 Gy HI = 50%

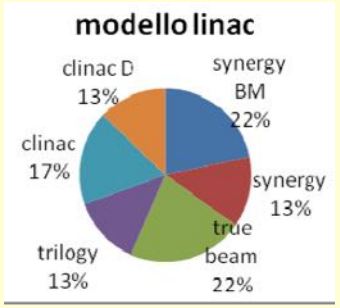
To be or not to be homogeneous?

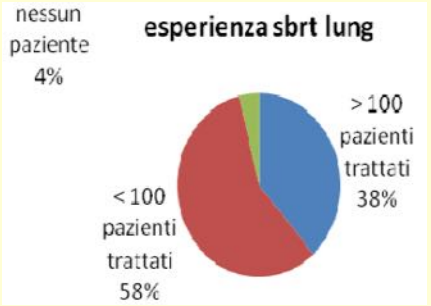
HUMANITAS CANCER CENTER

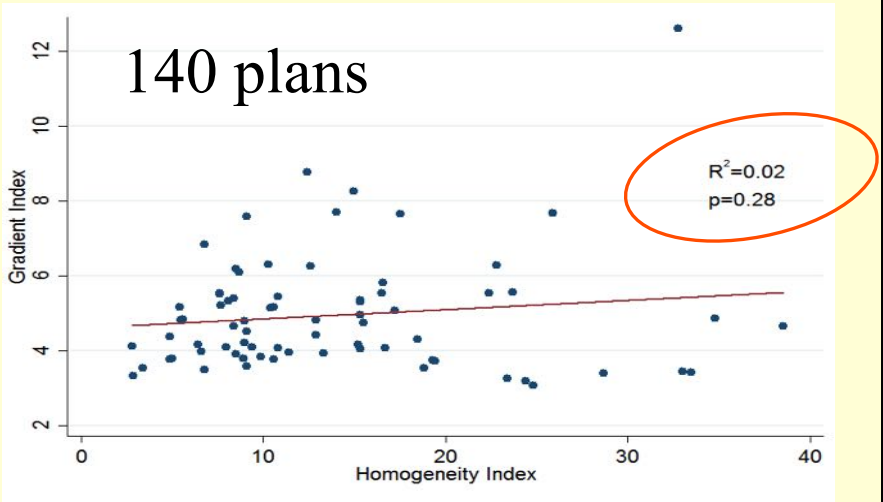


Mancosu, ESTRO 2013

Multiplanning SBRT lung (Giglioli, AIRO 2015) 28 centers involved







Small and Big

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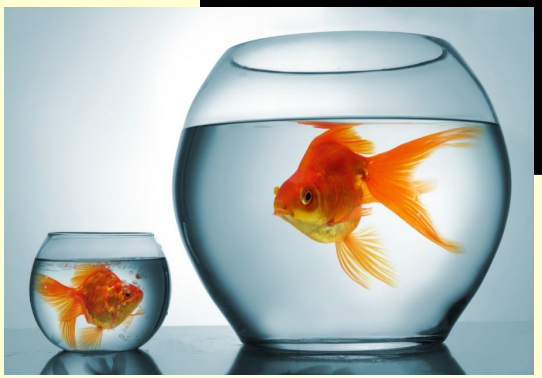

New imaging possibilities

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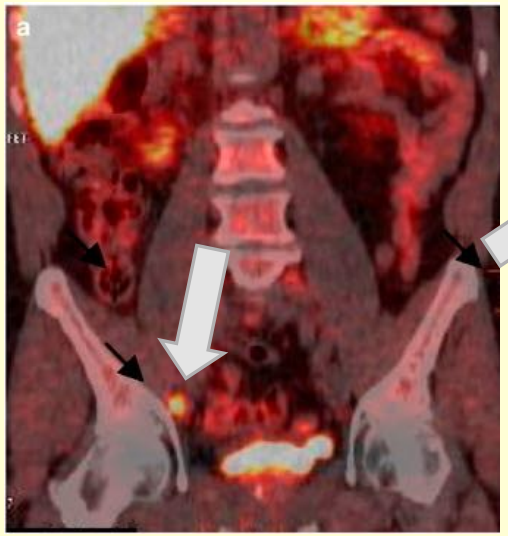

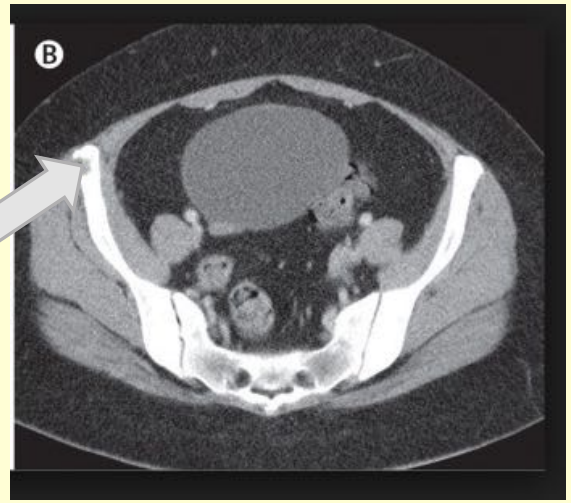

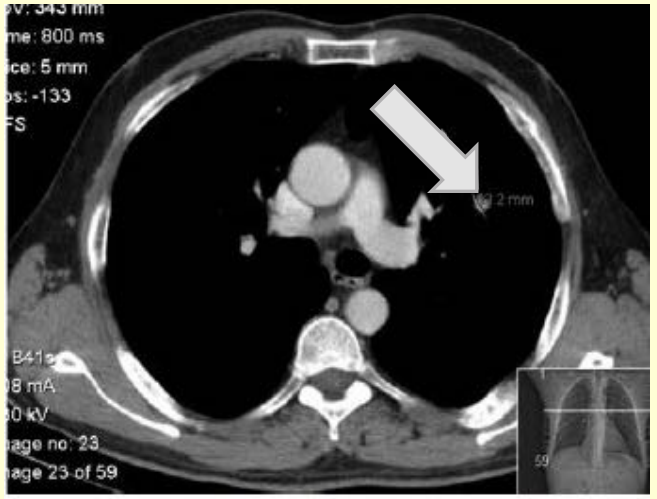

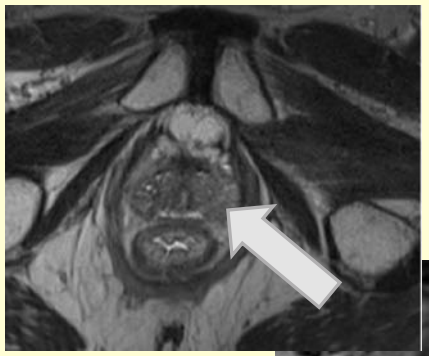

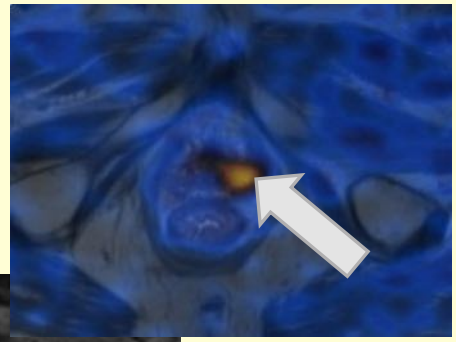

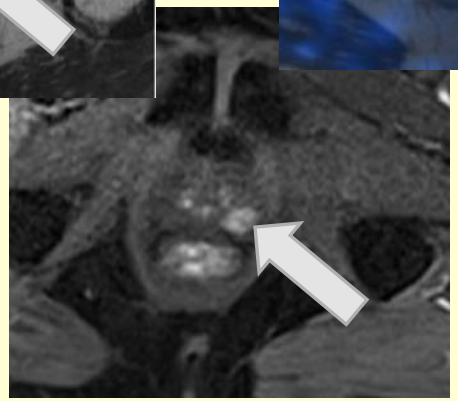

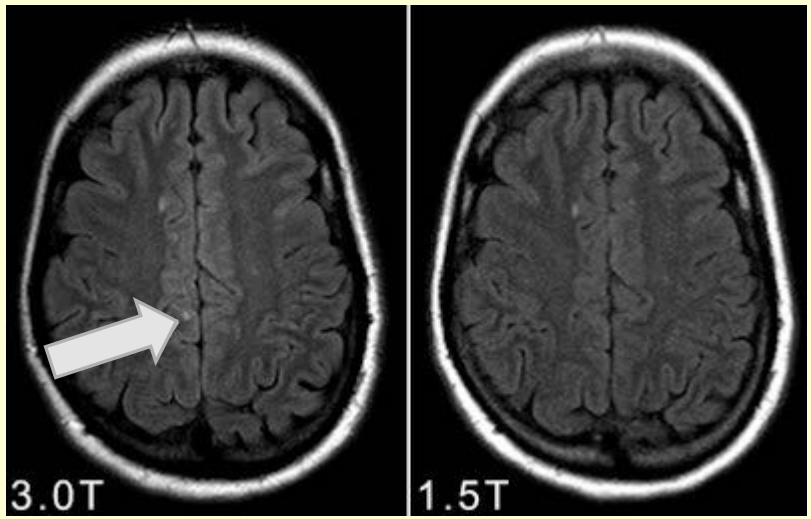

Waiting for Iori's presentation …

Small fields

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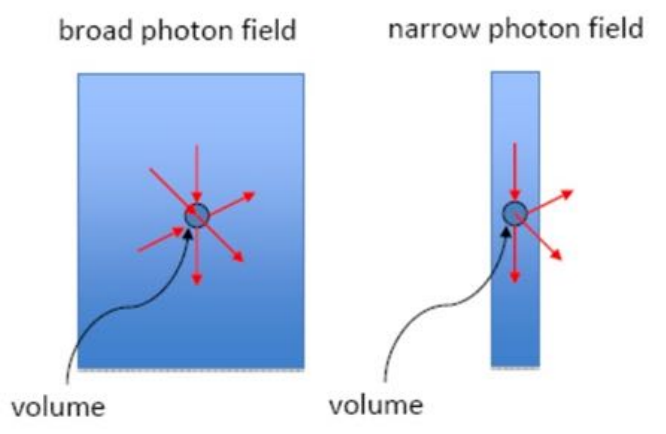
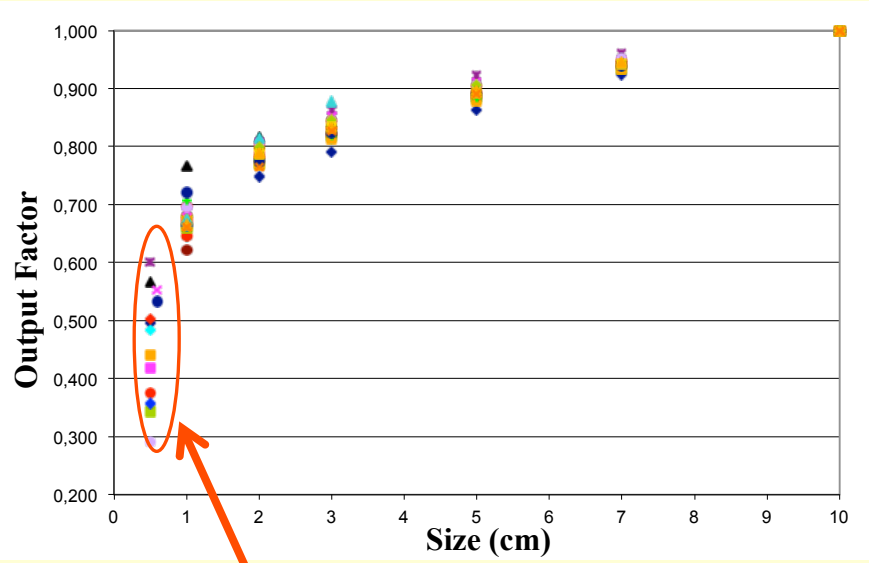
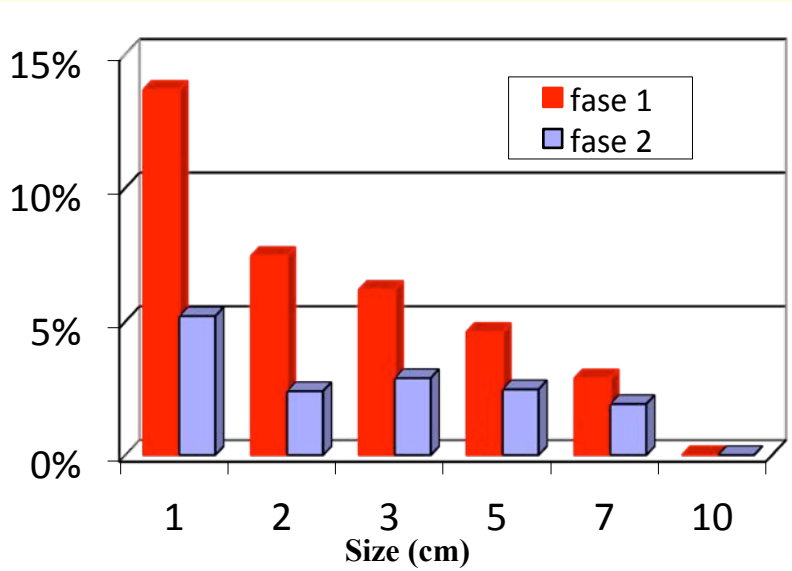
Lateral charged particle loss



27 centers
Output factor (5-100mm)
Square fields with jaws
Phase 1:
Own detector
Phase 2:
Common detector (diamond)



Trigeminal neuralgia size



Russo et al, Oral ESTRO 2015

Small fields

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THE UNIVERSITY OF TEXAS MD Anderson Cancer Center
Making Cancer History®

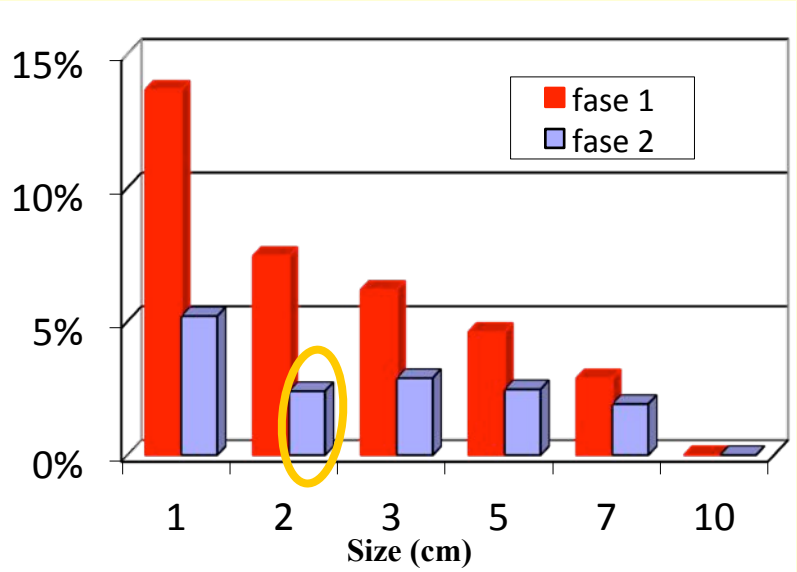
RPC Radiological Physics Center
Excellence through Quality Assurance

JOURNAL OF APPLIED CLINICAL MEDICAL PHYSICS, VOLUME 13, NUMBER 5, 2012

The Radiological Physics Center's standard dataset for small field size output factors

David S. Followill,[1a] Stephen F. Kry,[1] Lihong Qin,[2] Jessica Leif,[1] Andrea Molineu,[1] Paola Alvarez,[1] Jose Francisco Aguirre,[1] and Geoffrey S. Ibbott[1]

Field Size (*cm* × cm)	*Varian 6 MV* RPC	*Varian 6 MV* Institution	*Varian 10 MV* RPC	*Varian 10 MV* Institution
10 × 10	1.000	1.000	1.000	1.000
6 × 6	**0.921** (0.013) [0.9%] (n=64)	0.929 (0.004)	**0.946** (0.017) [0.7%] (n=9)	0.953 (0.016)
4 × 4	**0.865** (0.018) [1.3%] (n=64)	0.874 (0.021)	**0.900** (0.024) [1.3%] (n=9)	0.912 (0.030)
3 × 3	**0.828** (0.017) [1.7%] (n=62)	0.841 (0.025)	**0.867** (0.020) [1.2%] (n=9)	0.875 (0.025)
2 × 2	**0.786** (0.019) [2.3%] (n=55)	0.796 (0.031)	**0.817** (0.015) [1.8%] (n=11)	0.828 (0.019)



Russo et al, Oral ESTRO 2015

Small fields

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"Multicenter study of FFF beams with a new stereotactic diode: can be defined a universal OF curve?" (Cagni, Russo et al., ESTRO 2016)

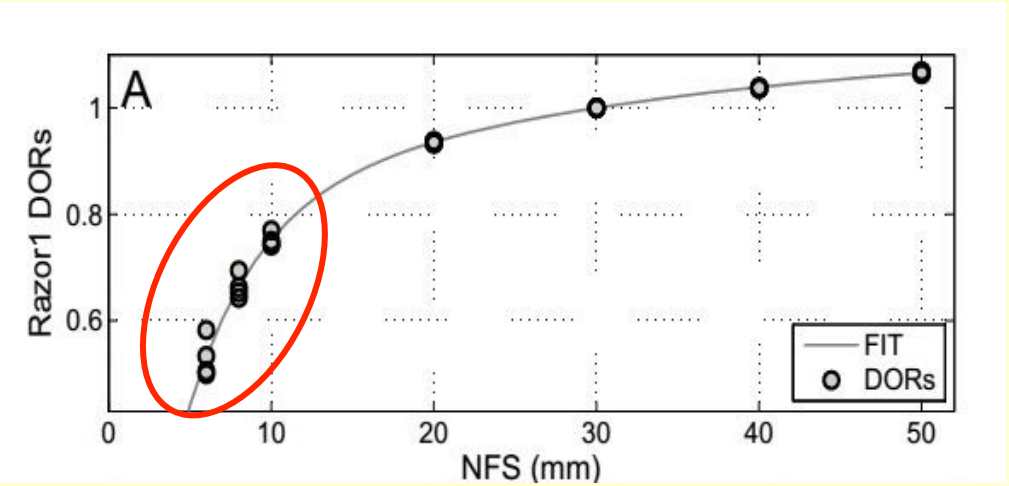
35 Linacs
7 TrueBeam
10 FFF
2400 MU/min
Output Factor: 6-50mm

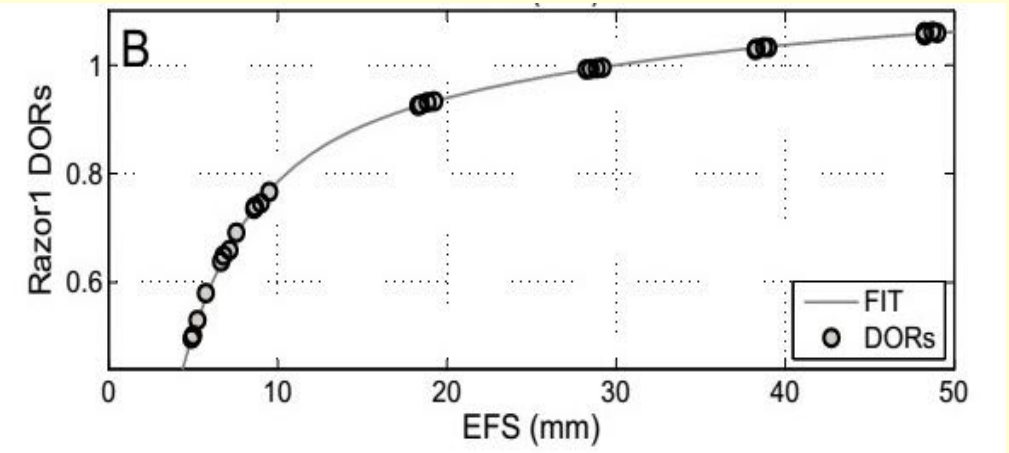
Nominal Field Size (NFS)

Effective field Size (EFS)

10 mm ± 1mm (i.e. up to 20% differences)
100 mm ± 1mm (i.e. <<1% differences)

Jaws intrinsic geometric uncertainty





Take home message

HUMANITAS CANCER CENTER

- SBRT treatment is increasing in many body regions
- Gray is Gray!
- All together we can impact on treatment quality

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CANCER CENTER

Thanks to:
Stefania Clemente
Marco Esposito
Christian Fiandra
Francesca Giglioli
Carmelo Marino
Michele Stasi
Lidia Strigari
Serenella Russo
Elena Villaggi

All GdL members

GdL SBRT aifm

aifm ASSOCIAZIONE ITALIANA DI FISICA MEDICA

Questions?

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