

AIRO2022

XXXII CONGRESSO NAZIONALE AIRO
XXXIII CONGRESSO NAZIONALE AIRB
XII CONGRESSO NAZIONALE AIRO GIOVANI

Radioterapia di precisione per un'oncologia innovativa e sostenibile



RADIOTERAPIA INTERVENTISTICA TRA INNOVAZIONE E SOSTENIBILITÀ

Innovazione nella radioterapia interventistica

LUCA TAGLIAFERRI - MD, PhD

Fondazione Policlinico Univeristario «Agostino Gemelli» IRCCS

Gemelli ART (Advanced Radiation Therapy) - Interventional Oncology Center (IOC)



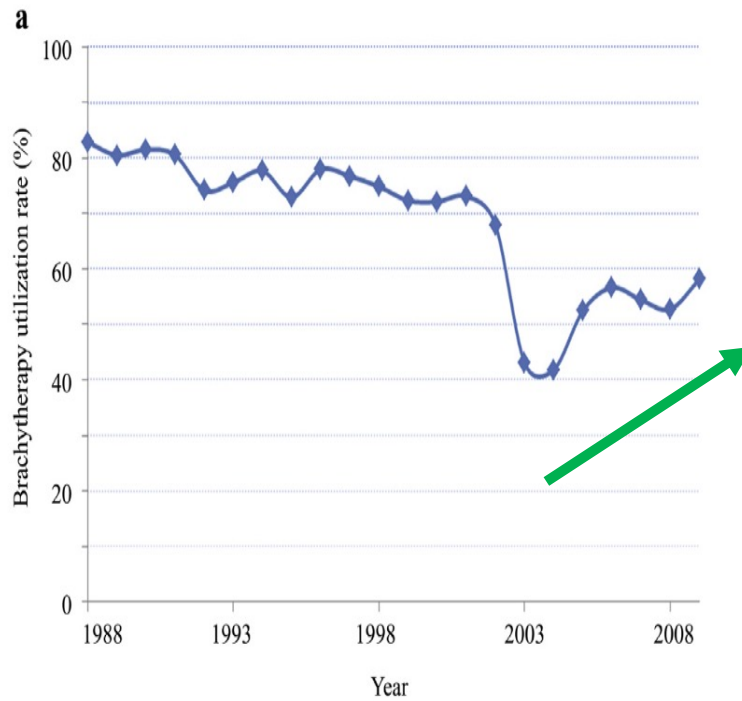
27 November 2022



CONFLICT OF INTEREST

- Elekta
- Igea Medical
- SunPharma
- Sanofi
- Roche
- Molipharma
- Nanobiotix

from CURIETHERAPY/BRACHYTHERAPY to INTERVENTIONAL RADIOETHERAPY

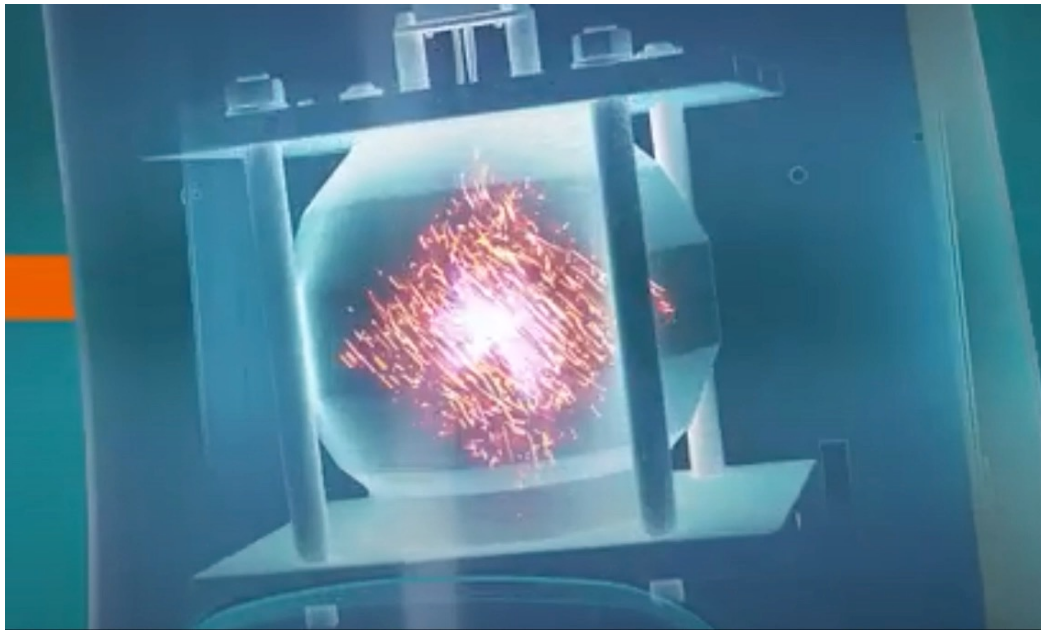


NEW ERA

:
Minimal Invasive Precision Medicine

from CURIETHERAPY/BRACHYTHERAPY to INTERVENTIONAL RADIOETHERAPY ERA

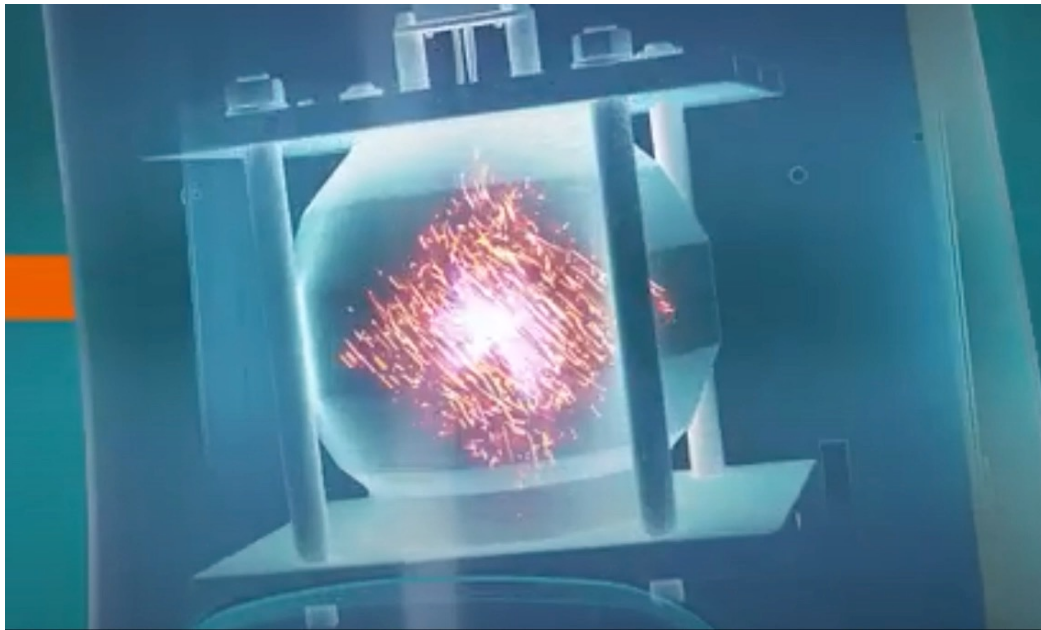
INNOVATION



- Intensity Modulated IRT
- Image Guided IRT
- New implant procedures
- AI and Omics guided IRT

from CURIETHERAPY/BRACHYTHERAPY to INTERVENTIONAL RADIOTHERAPY ERA

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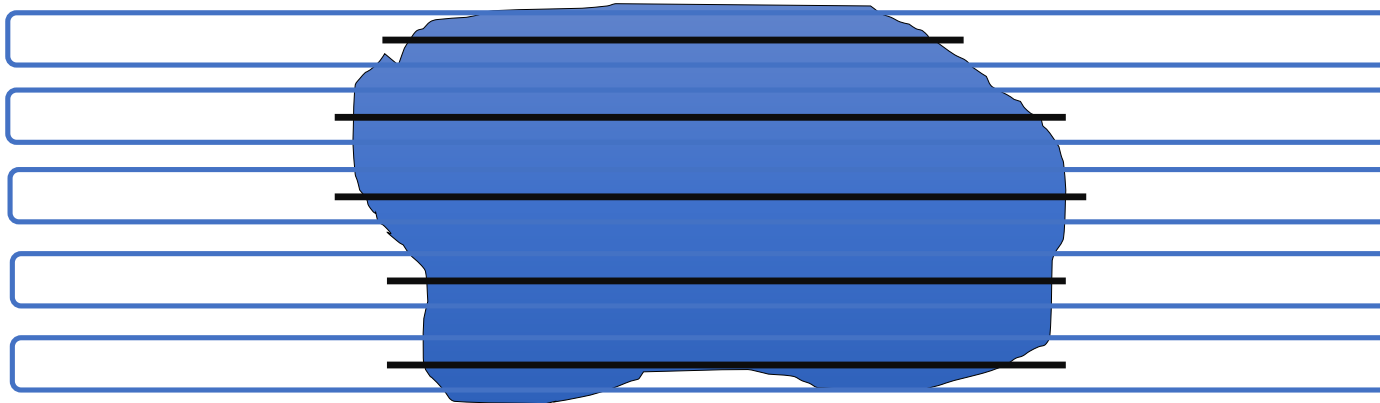
LINEAR SOURCES



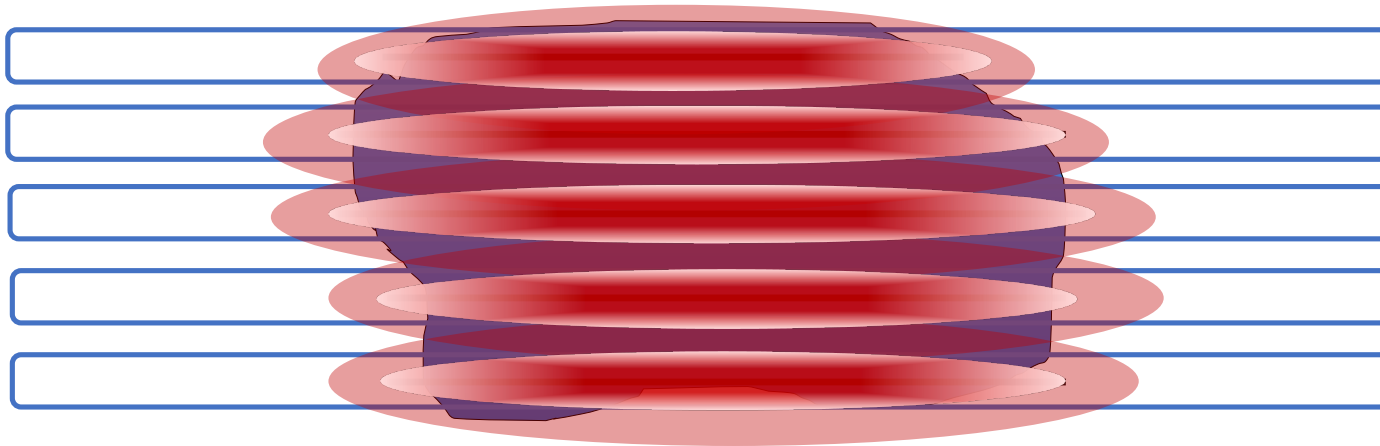
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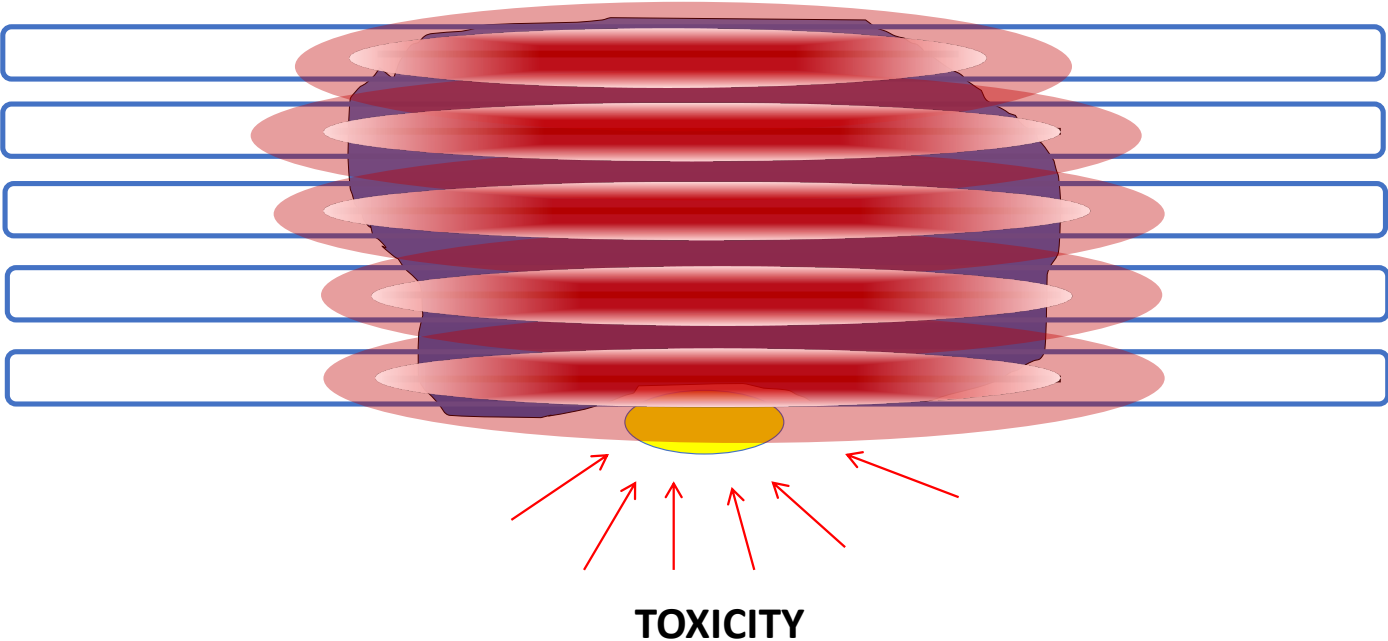
LINEAR SOURCES



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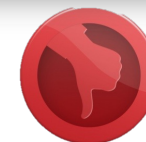


LINEAR SOURCES



BRACHYTHERAPY

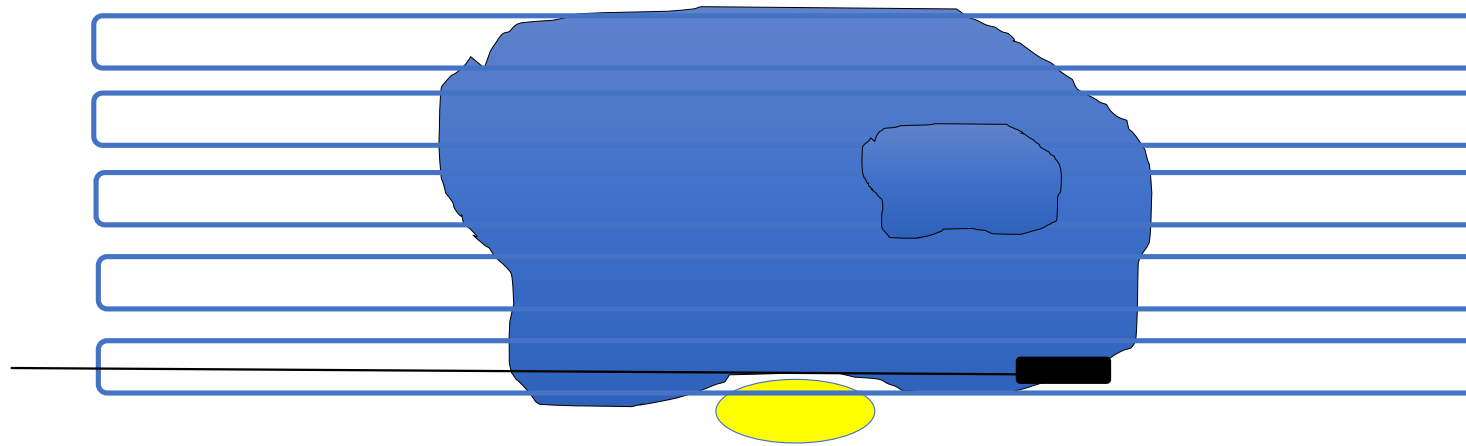
Author	n	Dose (Gy)	LDR	HDR	PDR	5 years local control (%)	5 years OS (%)	Toxicity
Beauvois <i>et al.</i> [21]	237	65-68	¹⁹² Ir	–	–	95	74	9.5% necrosis
Gerbaulet <i>et al.</i> [22]	231	76	¹⁹² Ir	–	–	95	n.d.	13.0% necrosis



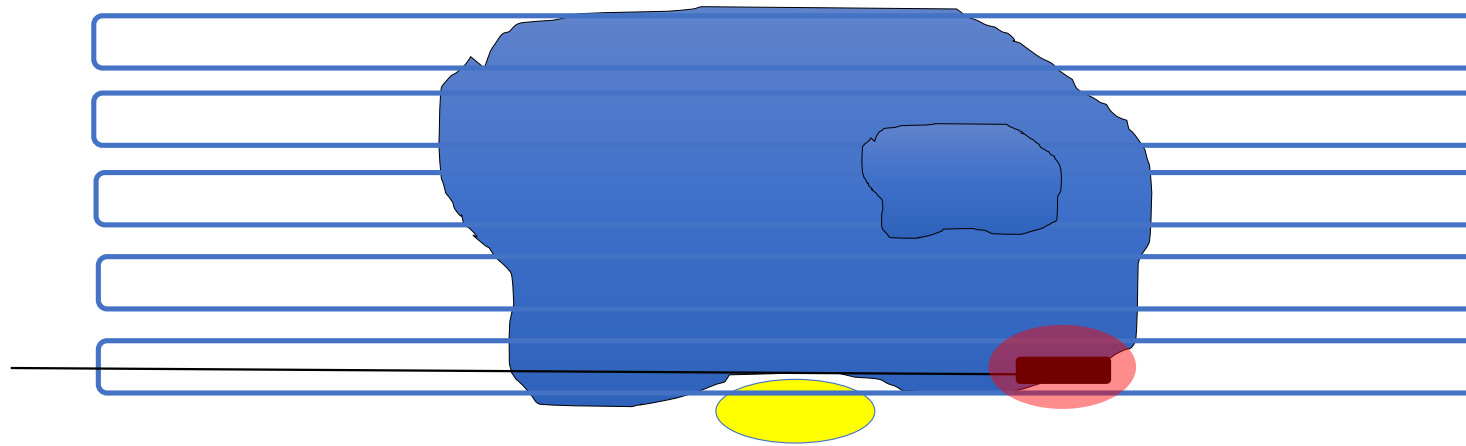
INTENSITY MODULATED INTERVENTIONAL RADIOOTHERAPY



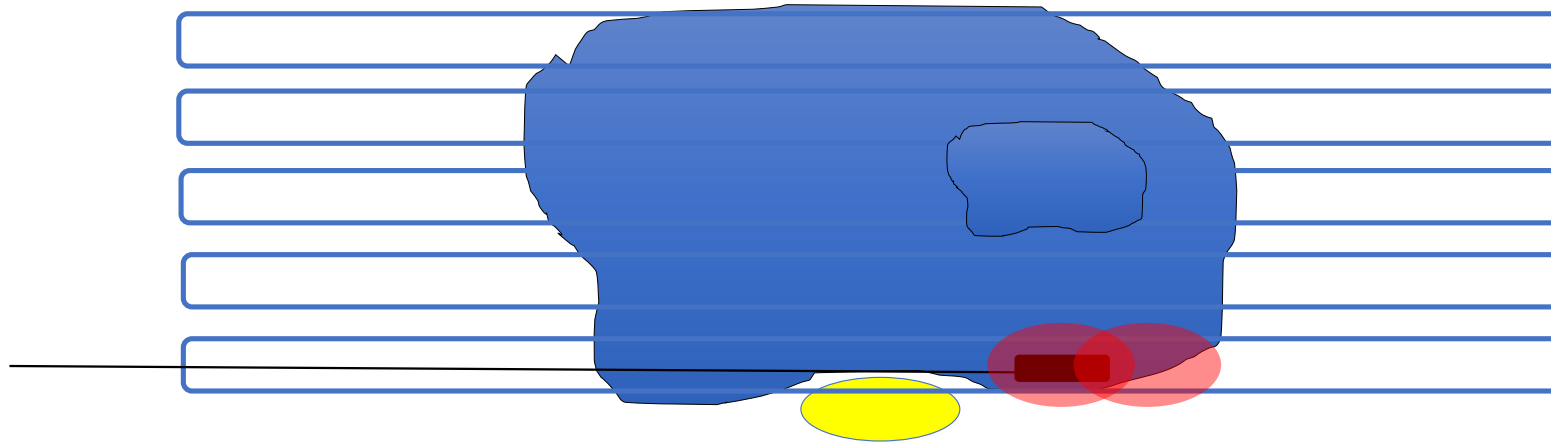
INTENSITY MODULATED INTERVENTIONAL RADIOLOGY



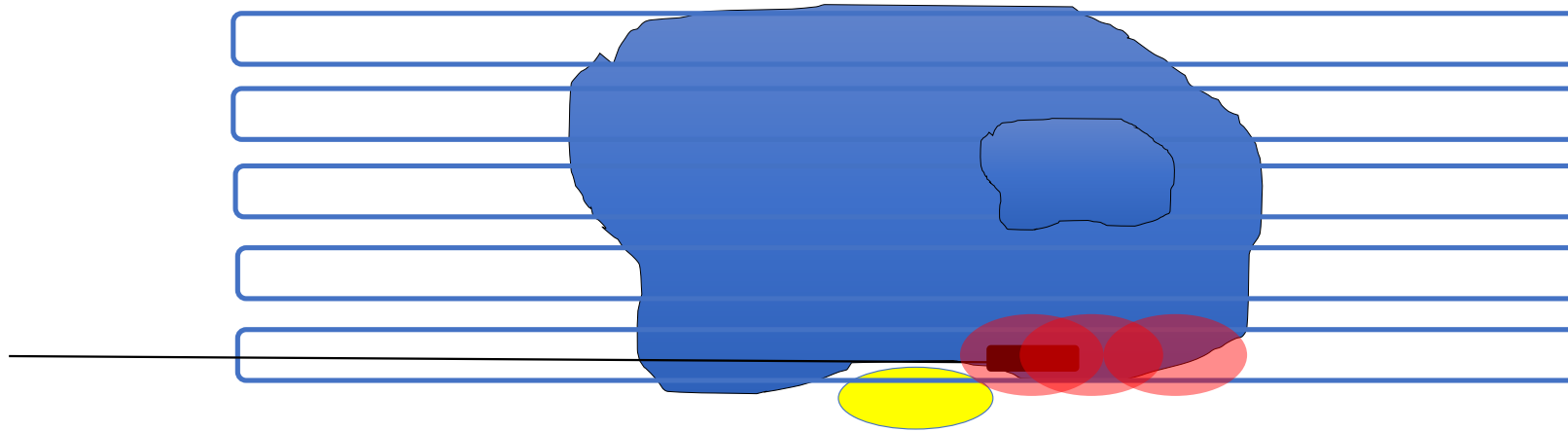
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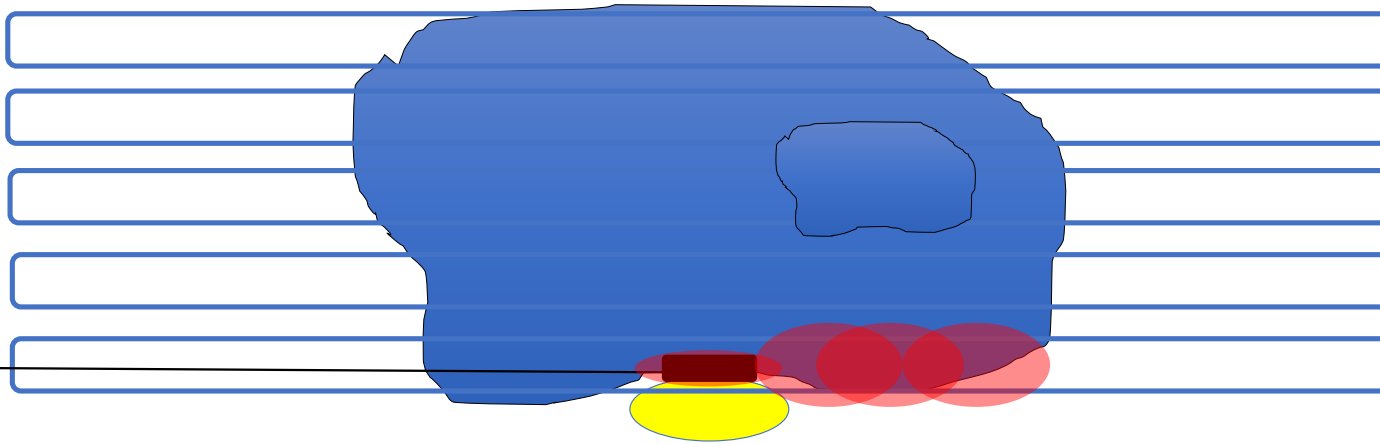
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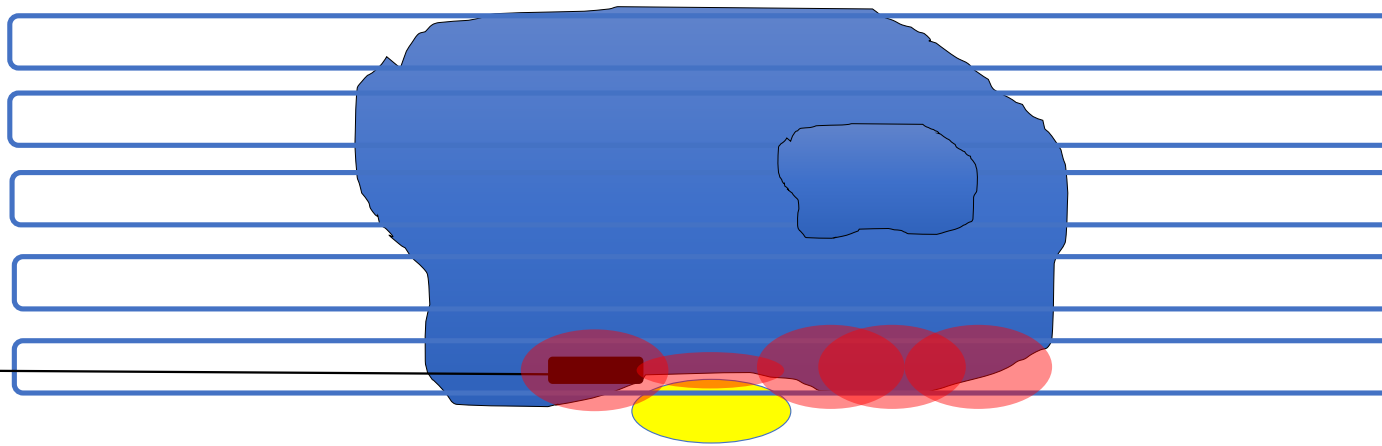
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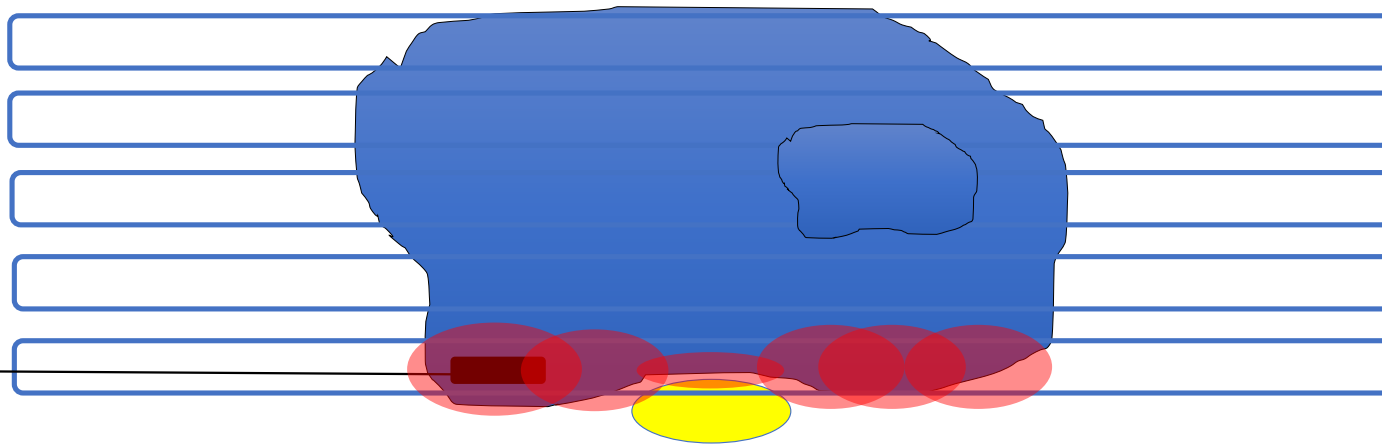
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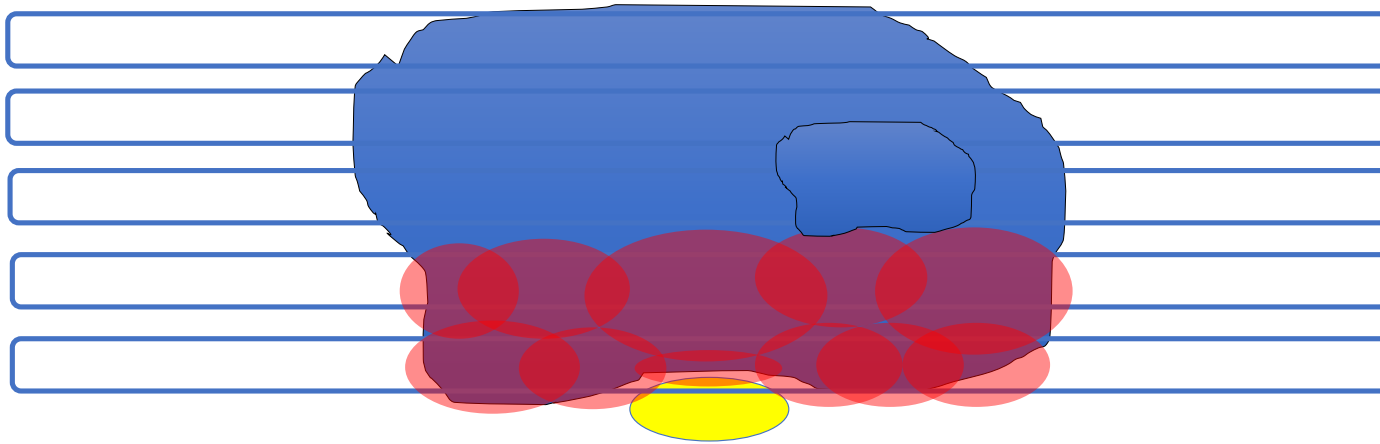
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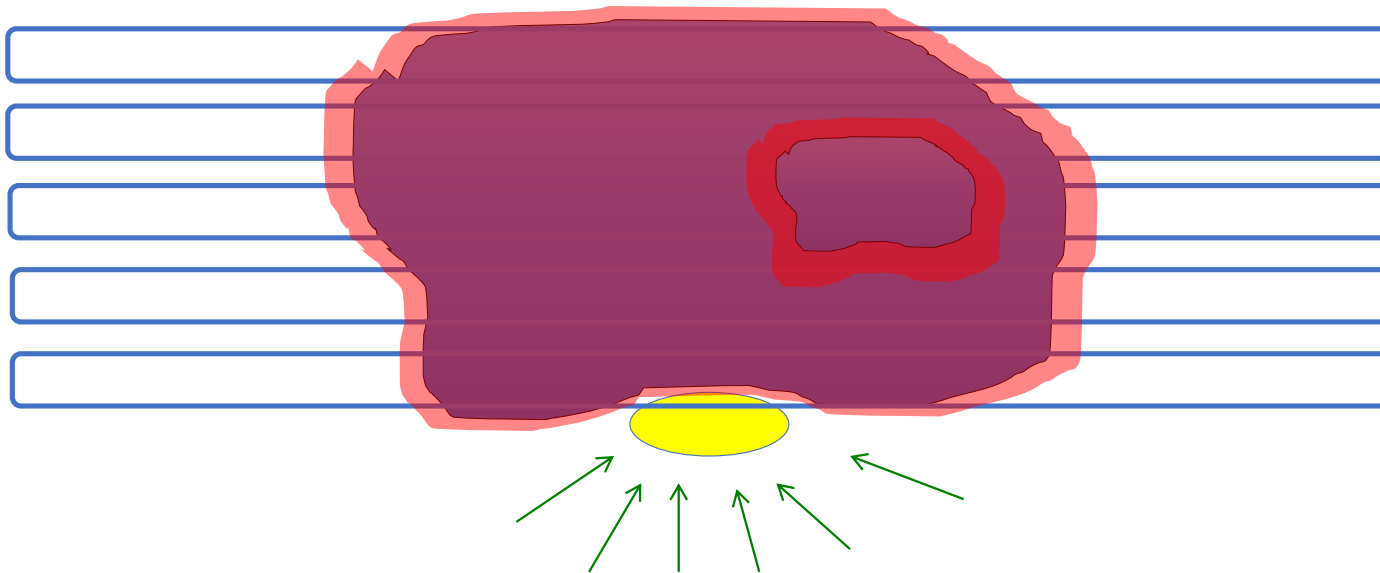
INTENSITY MODULATED INTERVENTIONAL RADIOLOGY



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Tombolini <i>et al.</i> [24]	57	62	–	HDR	–	90 (10 yrs)	n.d.	n.d.
Guinot <i>et al.</i> [26]	104	9 × 5.0 bid	–	HDR IMBT	–	95.2	64.4	0%
Lock <i>et al.</i> [173]	51	55	¹⁹⁸ Au	–	–	97.8	87.9	Good cosmesis 48/51
Serkies <i>et al.</i> [25]	32	60-70	–	–	PDR	98		2/32
Johansson <i>et al.</i> [20]	43	60	–	–	PDR	94.5 (10 yrs)	58.9 59.1 (10 yrs)	2% soft tissue necrosis 2% bone necrosis



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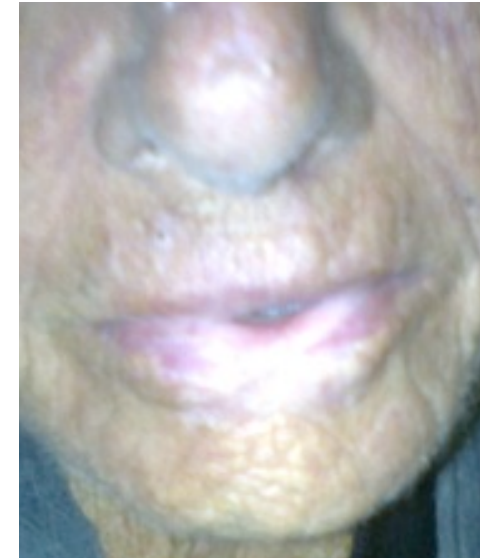
Linear S

IM-IRT

IM-IRT



INTENSITY MODULATED INTERVENTIONAL RADIOOTHERAPY

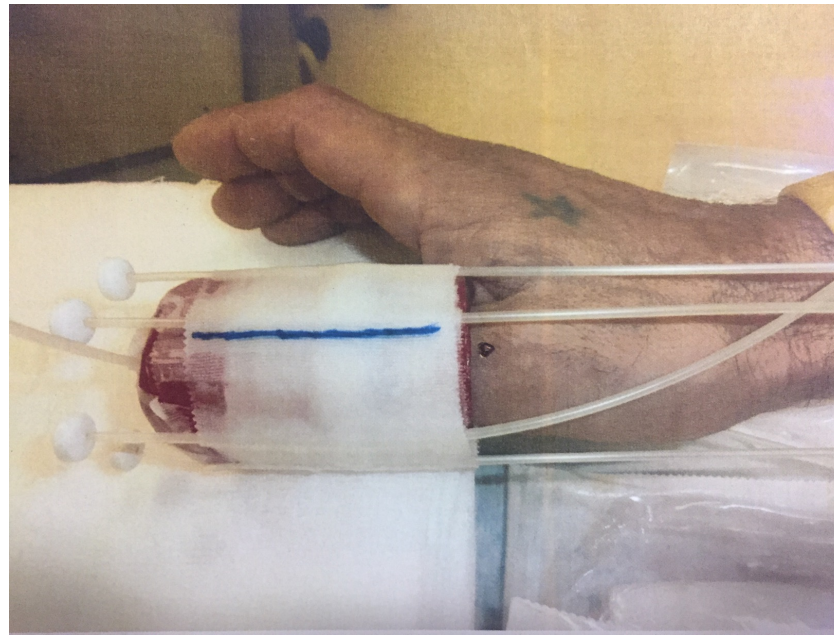
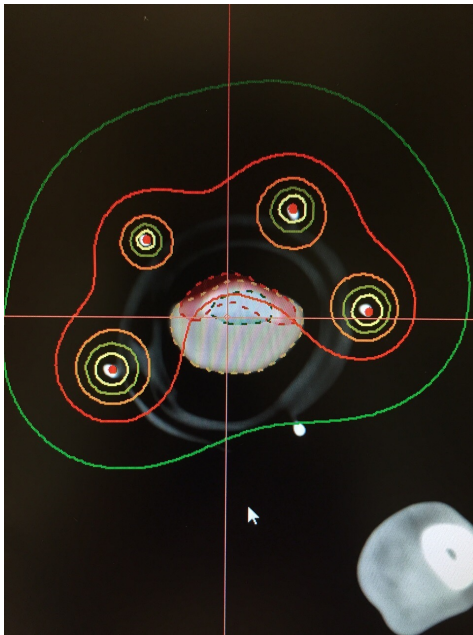


RADIOTHERAPY



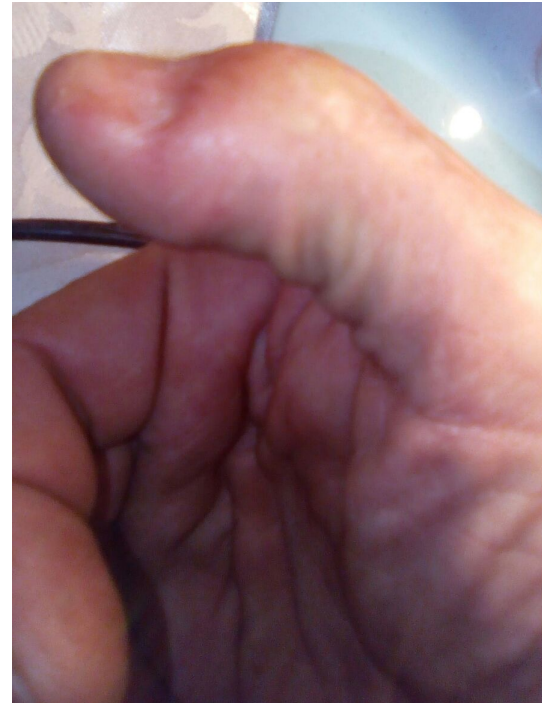
Electrician – refuses amputation

RADIOTHERAPY



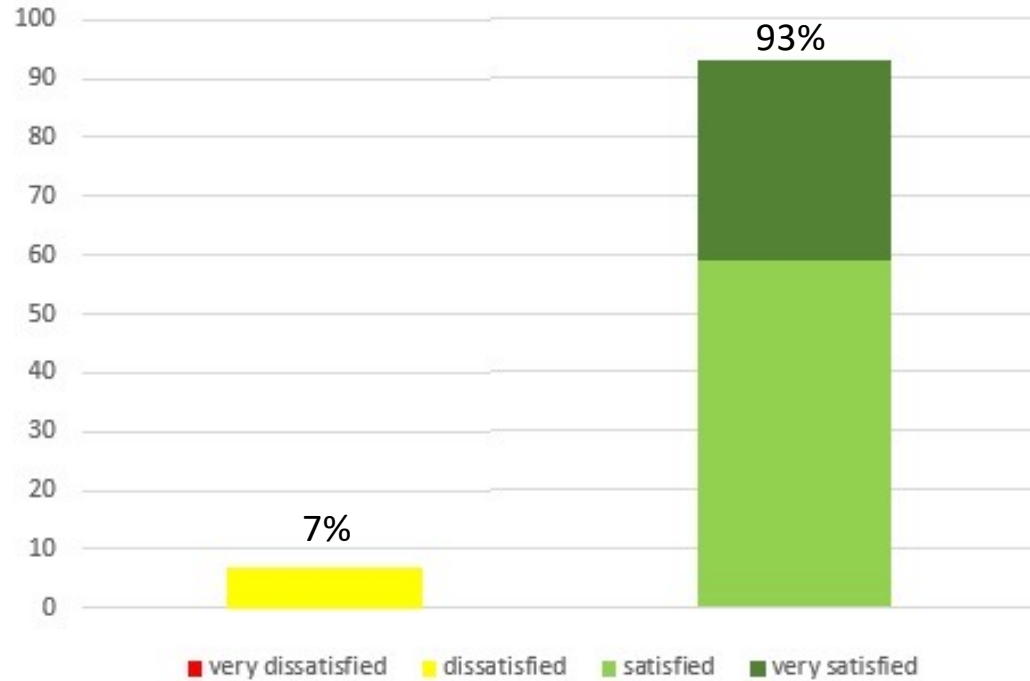
- Luca TAGLIAFERRI, Valentina LANCELLOTTA, Bruno FIONDA, Giulia PANZA, Patrizia CORNACCHIONE, Giuseppe COLLOCA, Luigi AZARIO, Gian Carlo MATTIUCI, Maria Antonietta GAMBACORTA, Vincenzo VALENTINI - Carcinoma of the Thumb Treated by "Function Sparing Approach" Using Contact Radiotherapy (Brachytherapy) Turk J Oncol 2019;34(4):283-6

RADIOTHERAPY



- Luca TAGLIAFERRI, Valentina LANCELLOTTA, Bruno FIONDA, Giulia PANZA, Patrizia CORNACCHIONE, Giuseppe COLLOCA, Luigi AZARIO, Gian Carlo MATTIUCCI, Maria Antonietta GAMBACORTA, Vincenzo VALENTINI - Carcinoma of the Thumb Treated by "Function Sparing Approach" Using Contact Radiotherapy (Brachytherapy) Turk J Oncol 2019;34(4):283–6

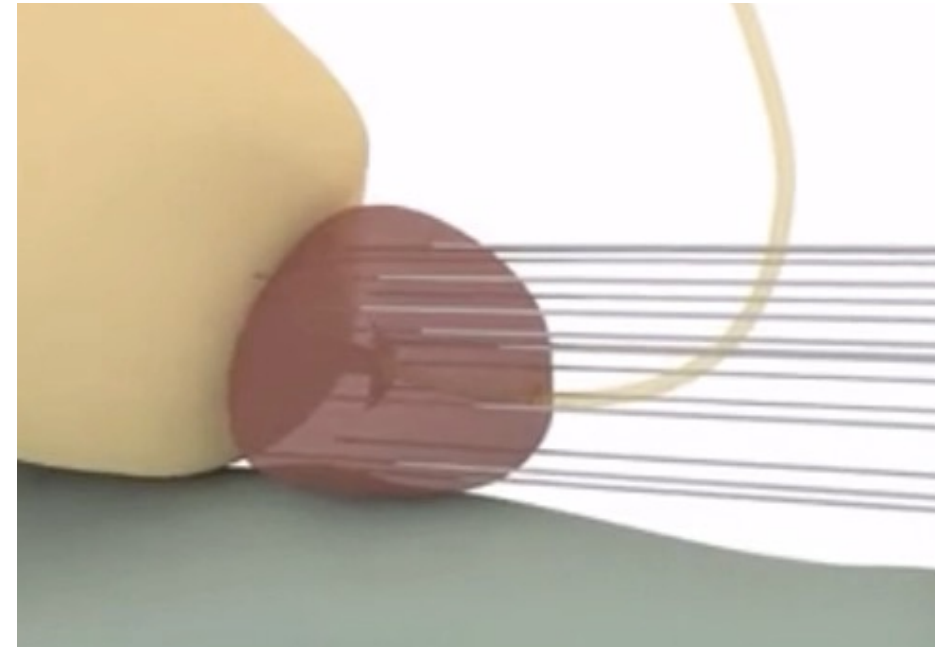
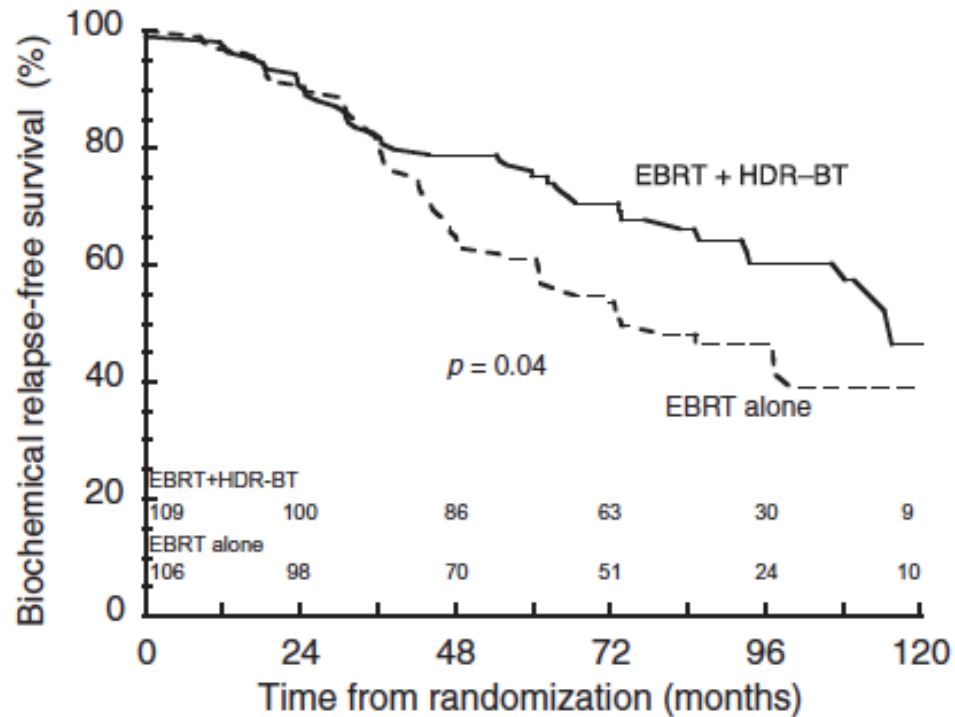
INTERVENTIONAL RADIOTHERAPY ERA



Before treatment

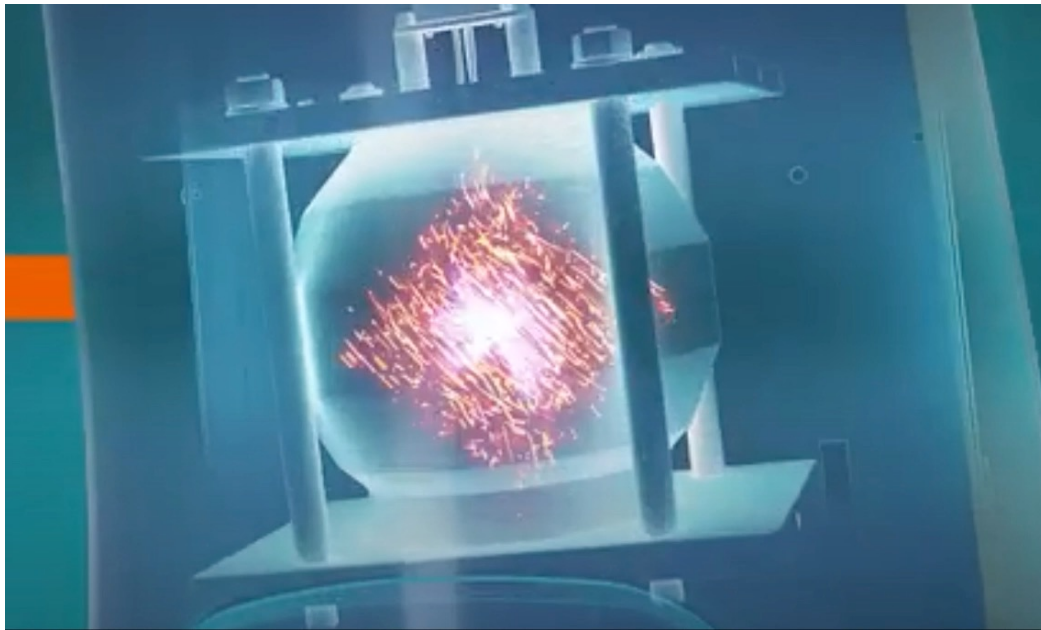
After treatment

INTENSITY MODULATED INTERVENTIONAL RADIOOTHERAPY



from CURIETHERAPY/BRACHYTHERAPY to INTERVENTIONAL RADIOOTHERAPY ERA

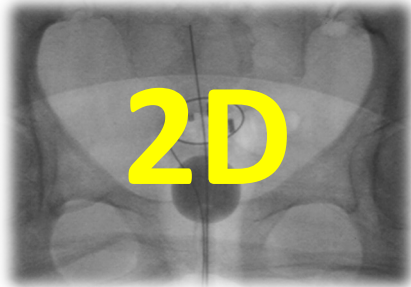
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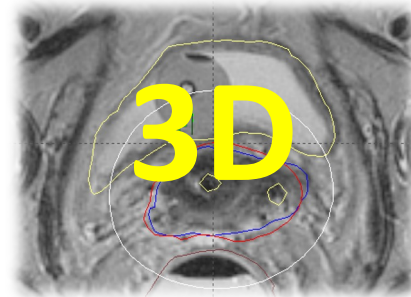
IMAGE GUIDED INTERVENTIONAL RADIOTHERAPY

CERVIX CANCER Local Control I Ib-IIIb



- Pernot M, et al. *Bull Cancer* 1995; 82(7):568 – 81.
- Gerbaulet A, et al. *The GEC ESTRO Handbook of Brachytherapy*
- Perez CA, et al. *Cancer* 1984; 54: 235-46.
- Fletcher GH, et al. *Textbook of radiotherapy. Philadelphia:1980; 720-89.*
- Pötter R, et al. *Bull Cancer Radiother* 2000; 4: 159 – 172.
- Horiot JC, et al. *Int J Radiat Oncol Biol Phys* 1988; 14(4): 605-11.

40 - 75%



- Pötter R. *Radiother Oncol* 2007
- Haie-Meder C. *Radiother Oncol* 2007
- Chargari C. *IJROBP* 2009
- Dimopoulos JCA. *Radiother Oncol* 2009
- Dimopoulos *IJROBP* 2009
- Fidarova EF et al. *Radiother Oncol* 2010
- Georg P et al. *IJROBP* 2009

80 - 95%
Less toxicity



IMAGE GUIDED INTERVENTIONAL RADIOOTHERAPY

3D CATHETERS RECONSTRUCTION AND 3D DOSIMETRY

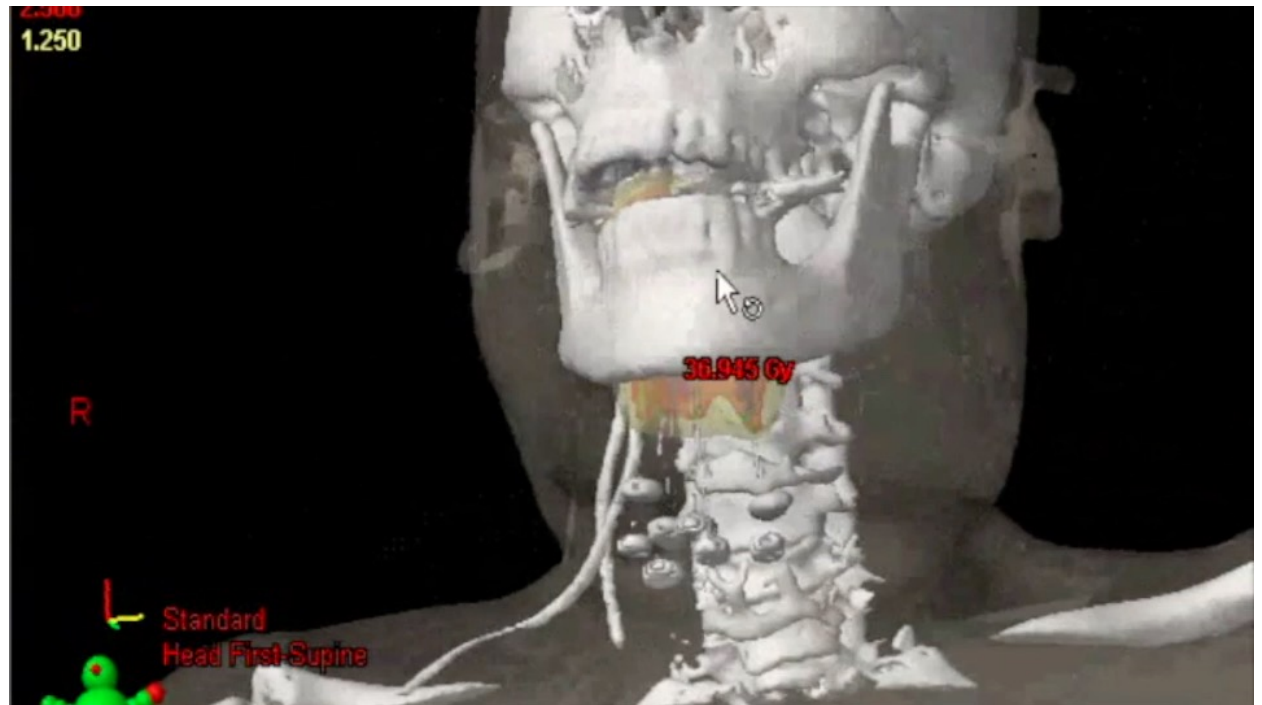
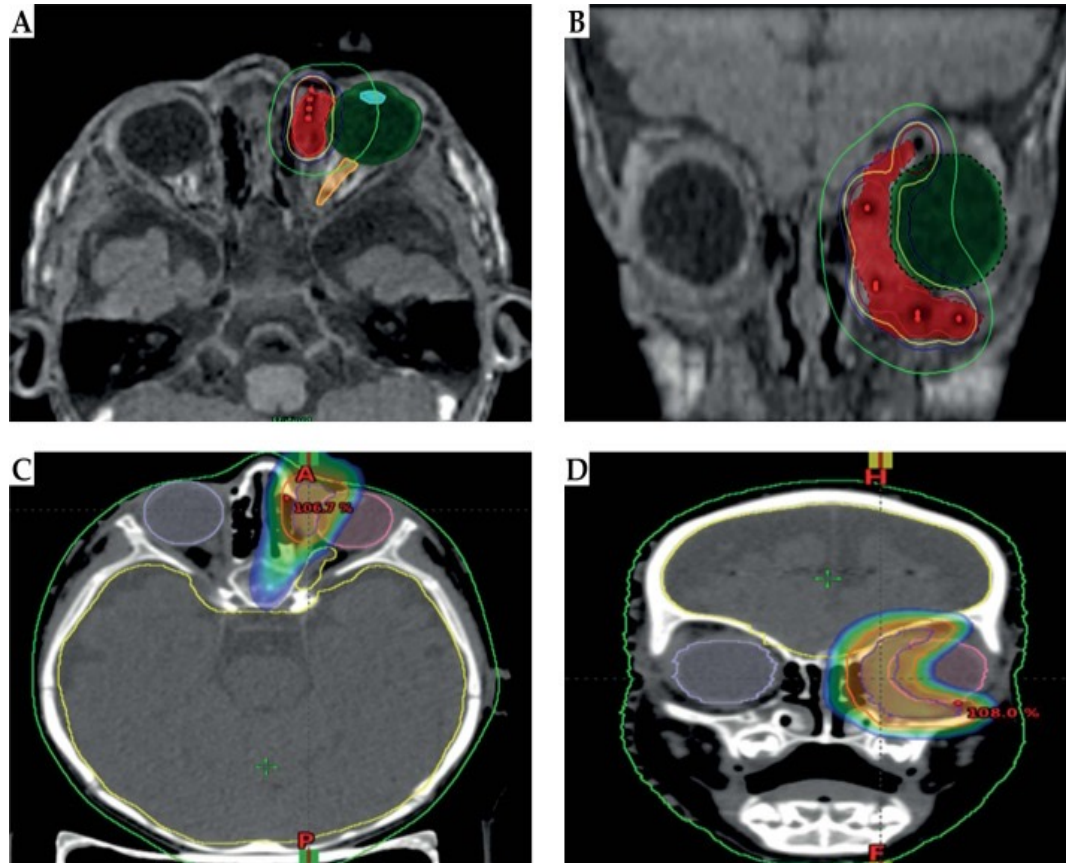
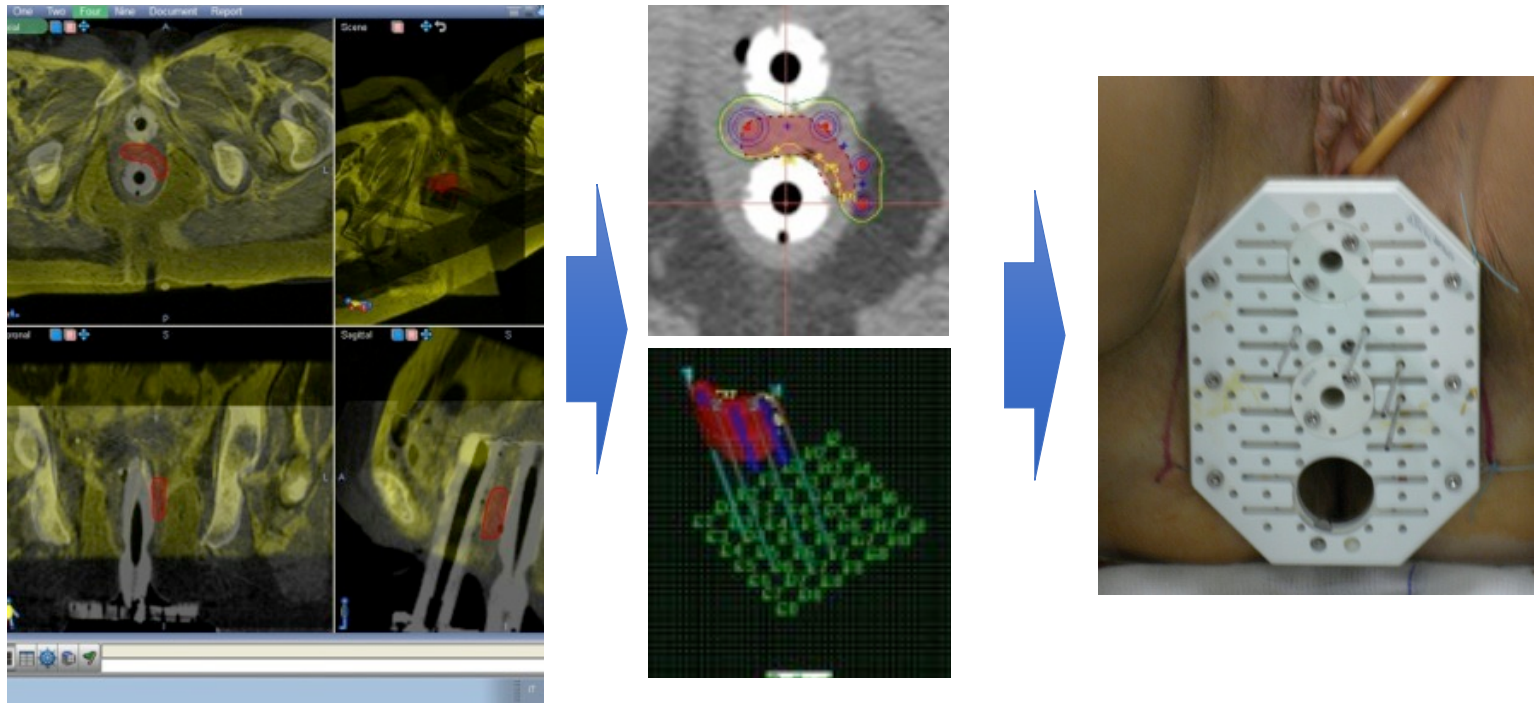


IMAGE GUIDED INTERVENTIONAL RADIOOTHERAPY



- Laskar S, Pilar A, Khanna N, Ghadi Y. Interstitial brachytherapy for orbital soft tissue sarcoma: an innovative technique. *Journal of Contemporary Brachytherapy*. 2017;9(5):466-471. doi:10.5114/jcb.2017.70957.

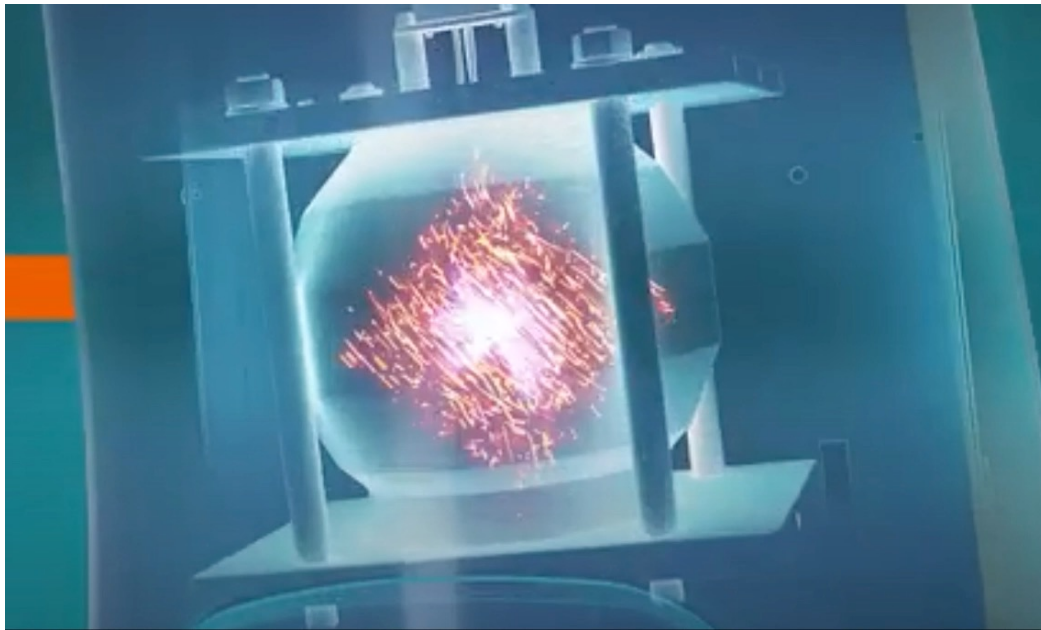
IMAGE GUIDED INTERVENTIONAL RADIOOTHERAPY



- Tagliaferri L, Manfreda S, Barbaro B, Colangione MM, Masiello V, Mattiucci GC, Placidi E, Autorino R, Gambacorta MA, Chiesa S, Mantini G, Kovács G, Valentini V. MITHRA - multiparametric MR/CT image adapted brachytherapy (MR/CT-IABT) in anal canal cancer: a feasibility study. **J Contemp Brachytherapy. 2015**

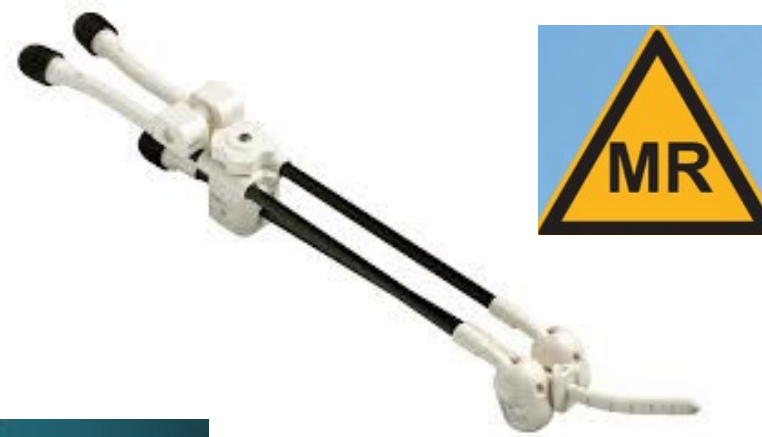
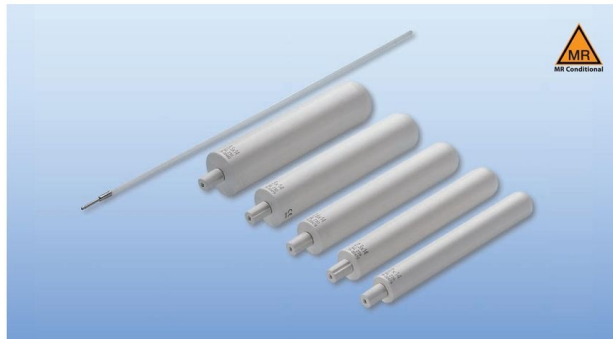
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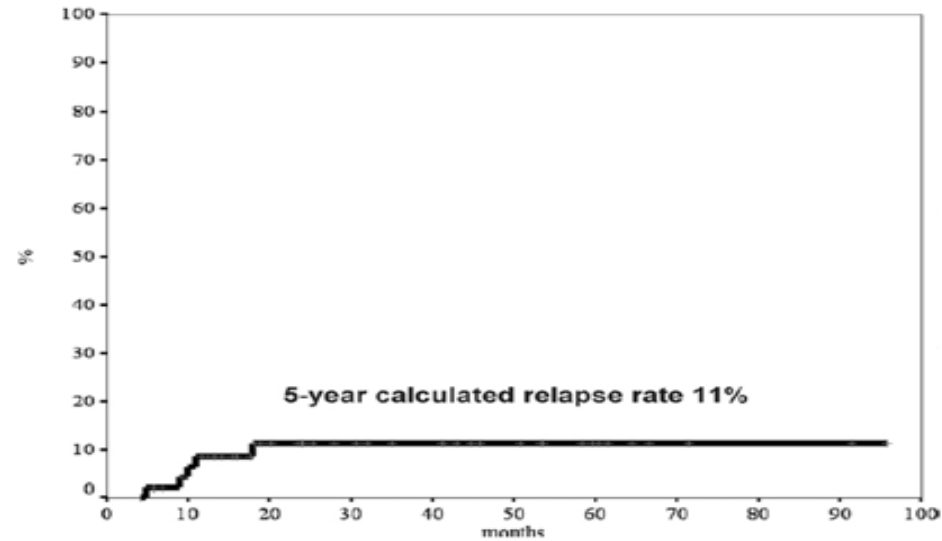
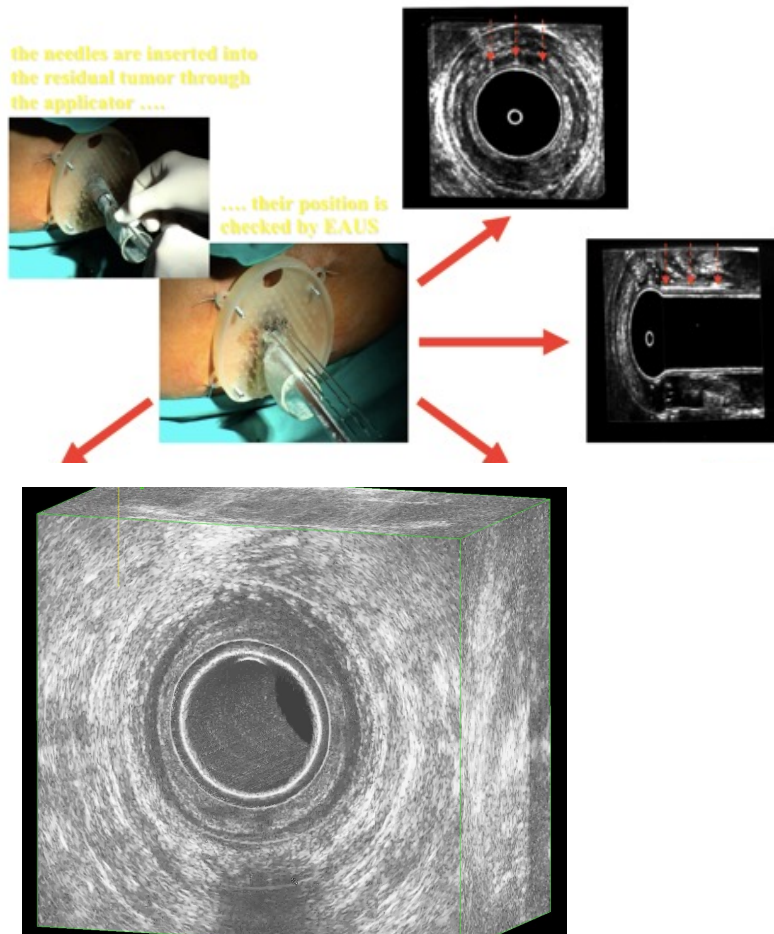
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NEW IMPLANT PROCEDURES



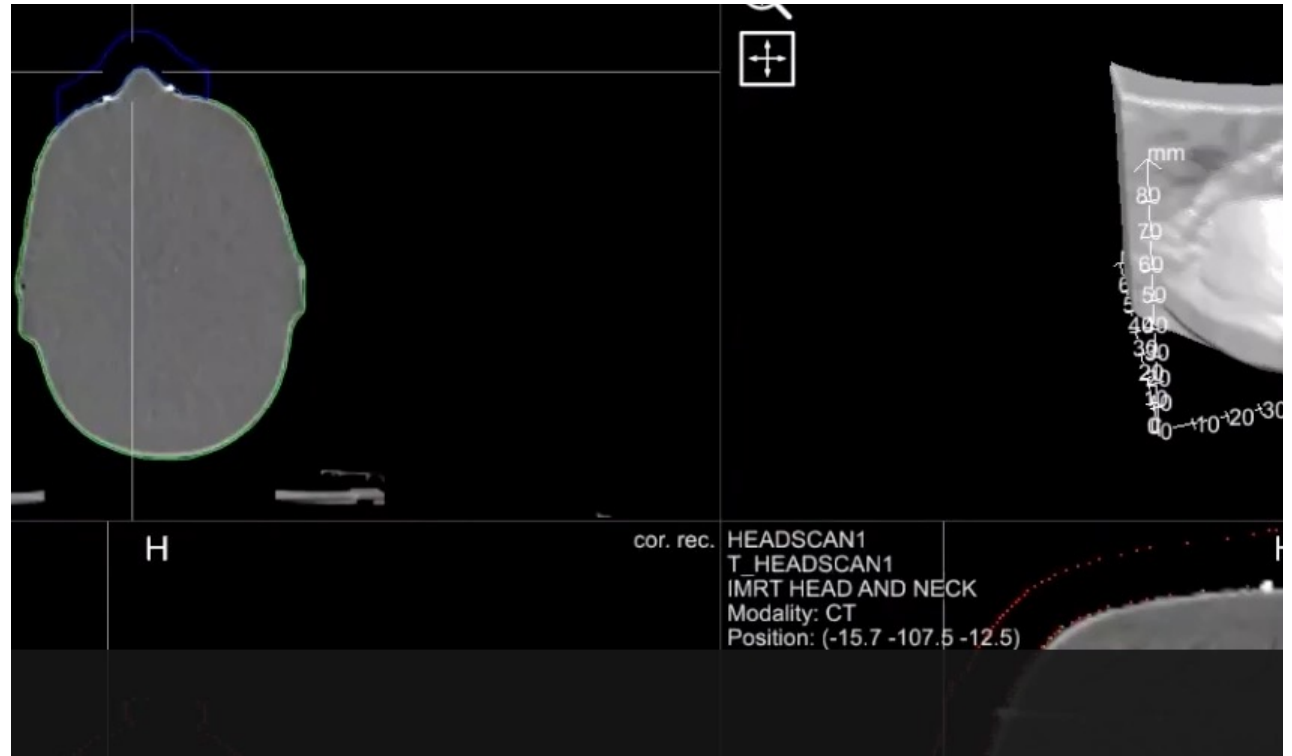
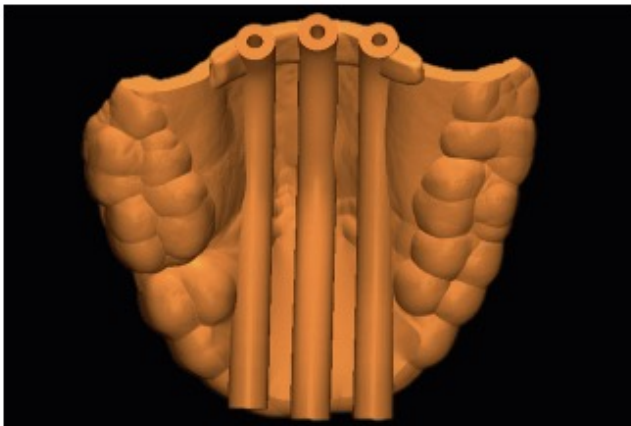
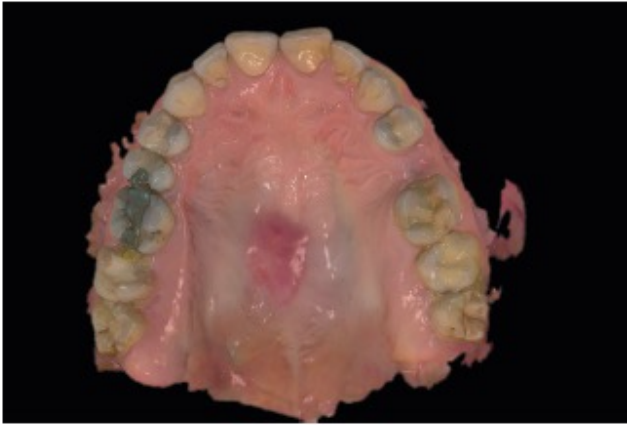
INTERDISCIPLINARY APPROACH in INTERVENTIONAL RADIOTHERAPY

US GUIDED IRT



no anal stenosis – 6% anal incontinence
no necrosis with standard dose (4Gy + 4Gy)

NEW IMPLANT PROCEDURES



INTERVENTIONAL RADIOTHERAPY

Editorial

Is an Interventional Oncology Center an advantage in the service of cancer patients or in the education? The Gemelli Hospital and INTERACTS experience

Prof. György Kovács, MD, PhD^{1,2}, Luca Tagliaferri, MD, PhD^{3,4}, Prof. Vincenzo Valentini, MD, PhD^{5,6}

¹Interdisciplinary Brachytherapy Unit, University of Lübeck/UKSH-CL, Germany, ²INTERACTS Scientific Program Director, ³Polo Scienze Oncologiche ed Ematologiche, Università Cattolica del Sacro Cuore, Fondazione Policlinico Universitario Agostino Gemelli, Roma, Italy, ⁴INTERACTS courses organizer, ⁵Polo Scienze Oncologiche ed Ematologiche, Istituto di Radiologia, Università Cattolica del Sacro Cuore, Fondazione Policlinico Universitario Agostino Gemelli, Roma, Italy, ⁶INTERACTS School Director



- *Kovács G, Tagliaferri L, Valentini V. Is an Interventional Oncology Center an advantage in the service of cancer patients or in the education? The Gemelli Hospital and INTERACTS experience. J Contemp Brachytherapy. 2017*

INTERDISCIPLINARY APPROACH in INTERVENTIONAL RADIOTHERAPY



CHOICE OF THE BEST COMBINED PERSONALIZED APPROACH

Improving local control

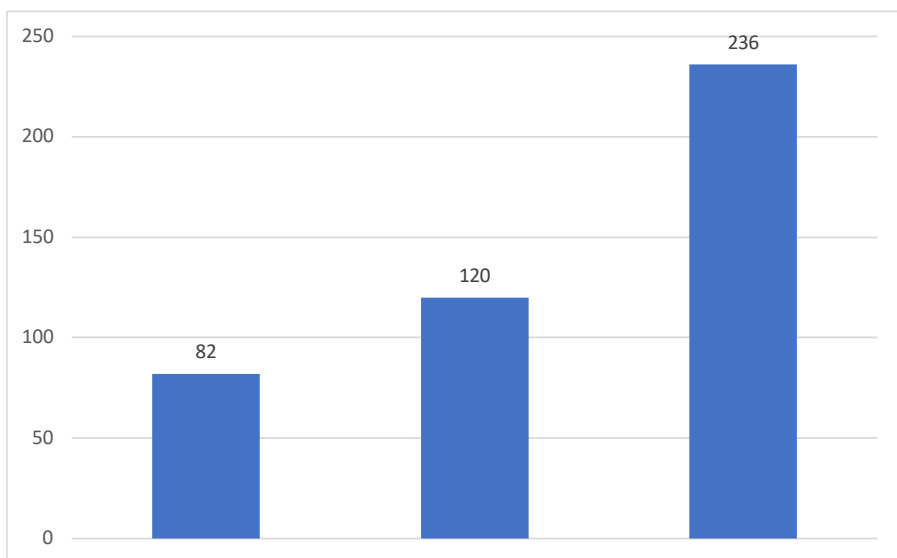
(SVV, DFS)

Reduction Toxicity

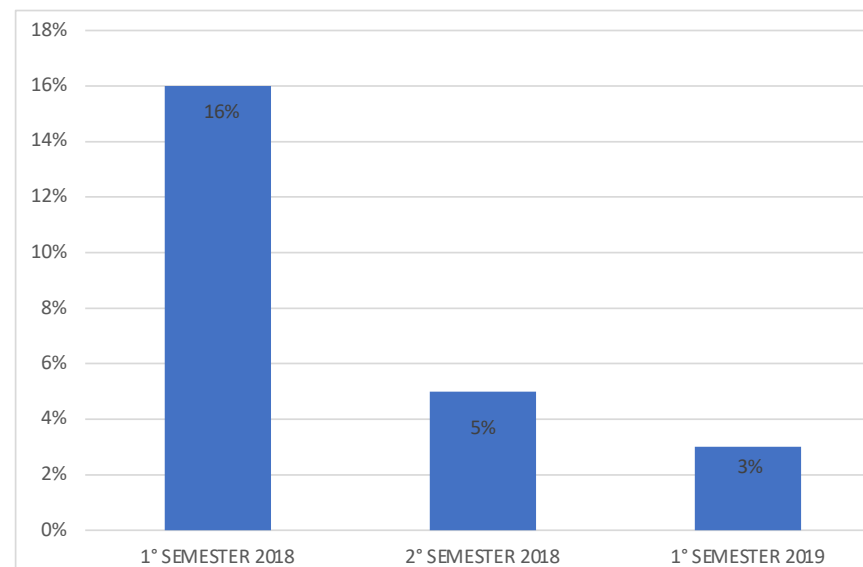
(organ preservation, QoL)

INTERDISCIPLINARY APPROACH in INTERVENTIONAL RADIOOTHERAPY

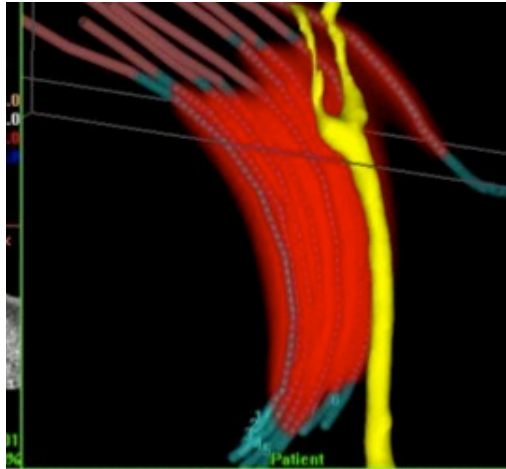
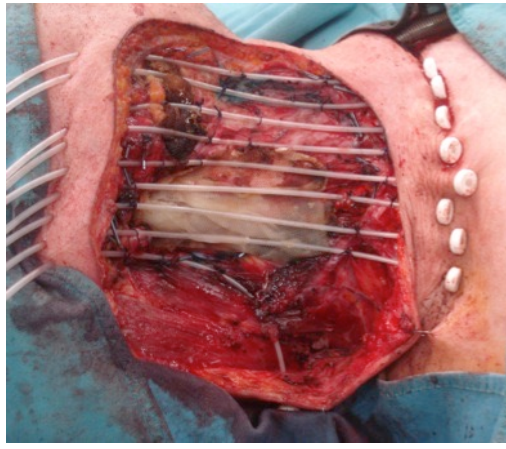
NUMBER OF PATIENTS



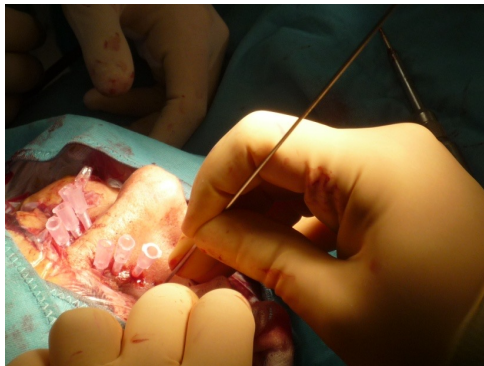
COMPLICATIONS



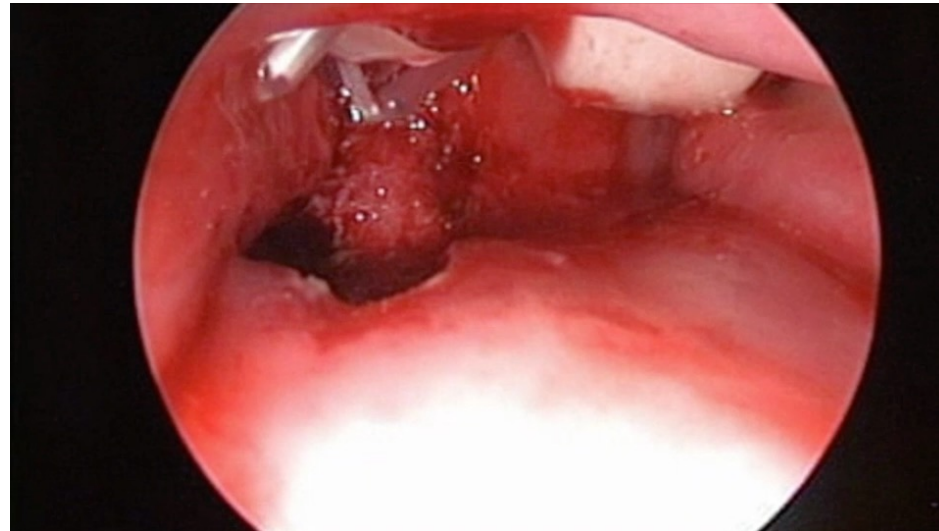
INTERDISCIPLINARY APPROACH in INTERVENTIONAL RADIOTHERAPY



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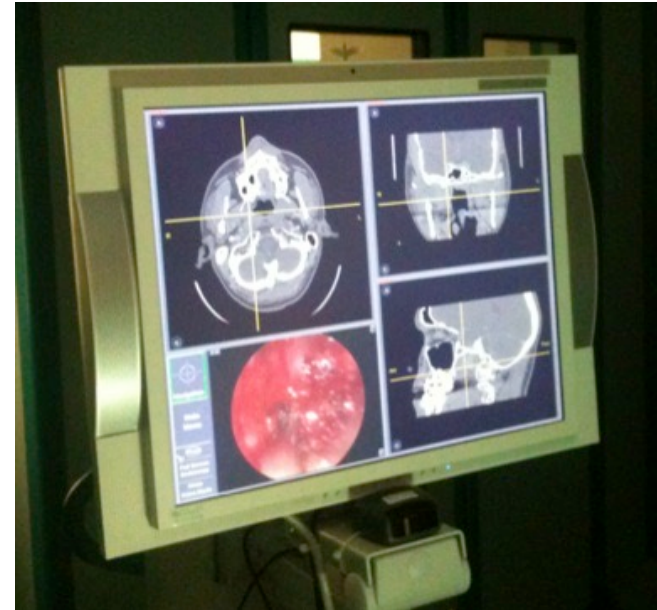
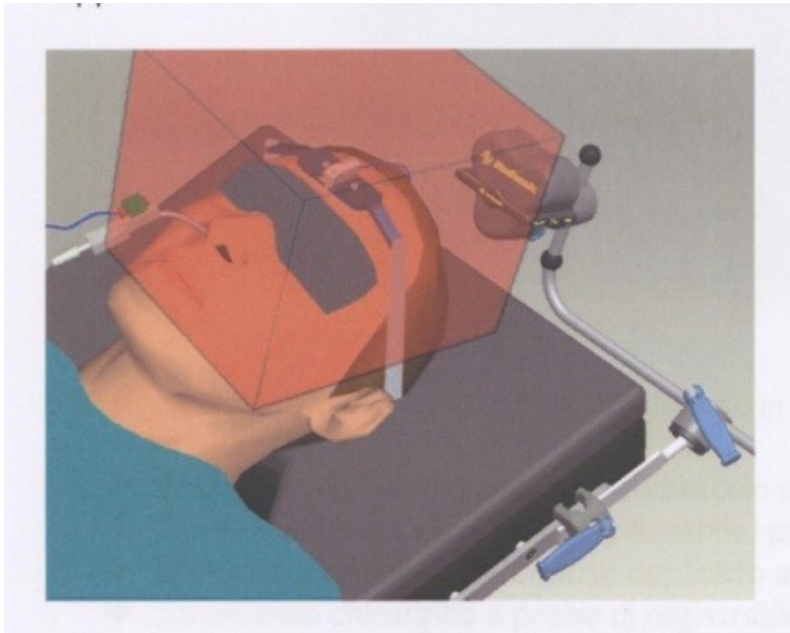


Endoscopy Guided Procedure

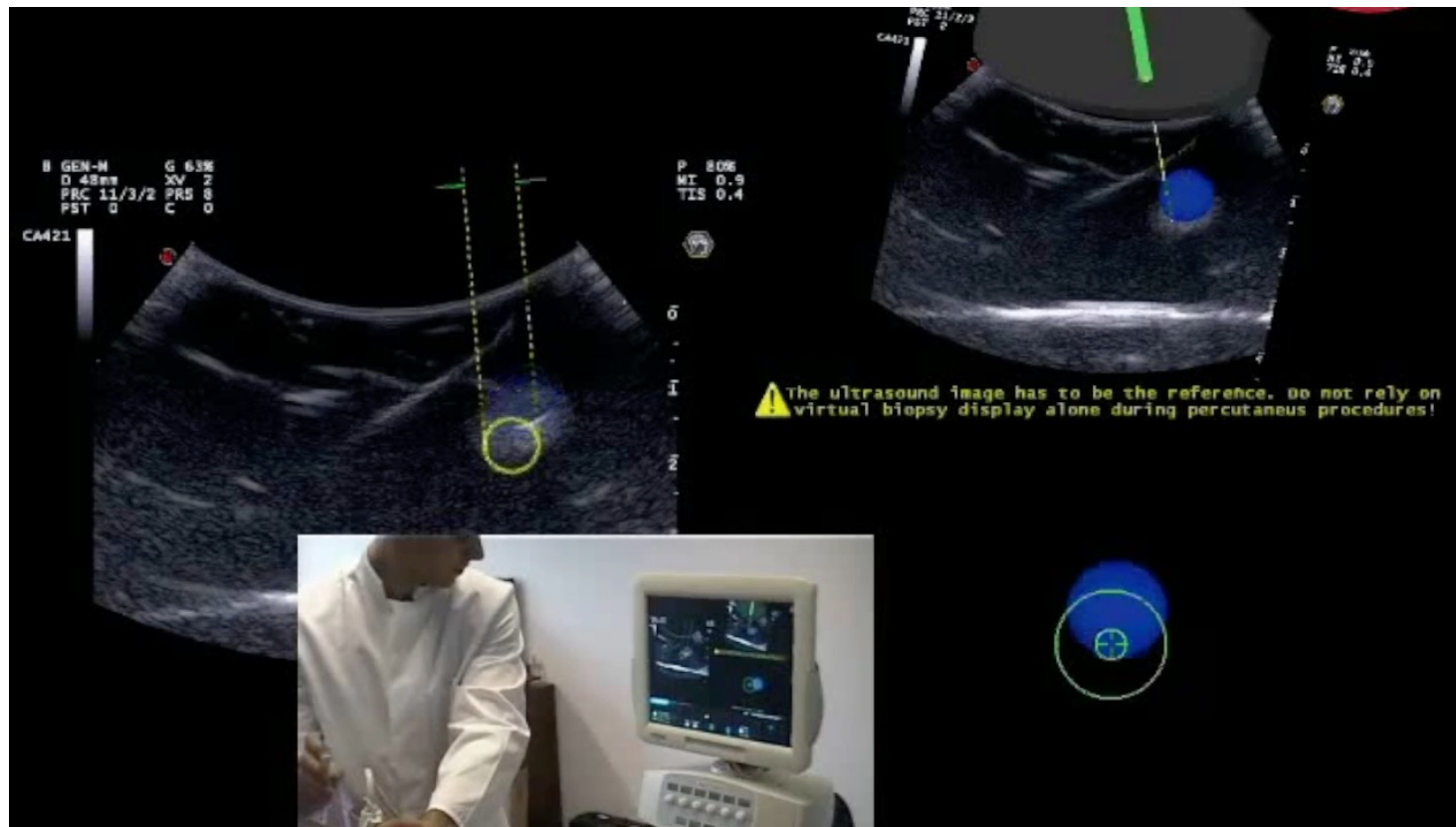


INTERDISCIPLINARY APPROACH in INTERVENTIONAL RADIOLOGY

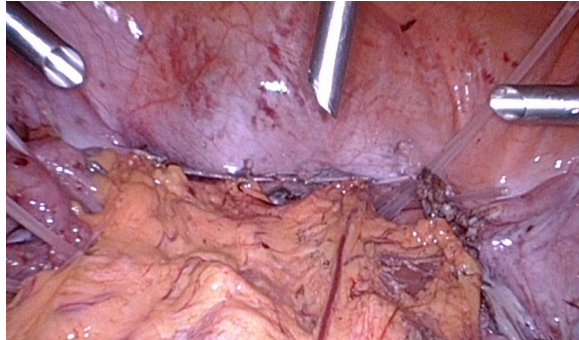
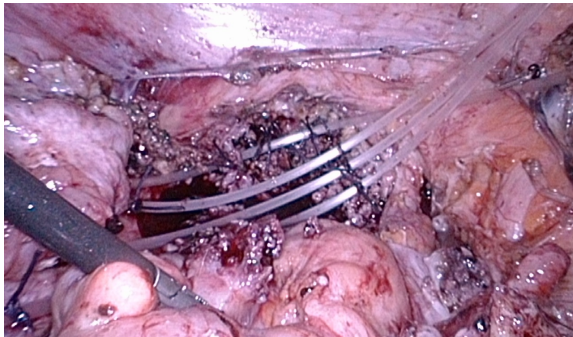
Neuro-navigator Guided Procedure



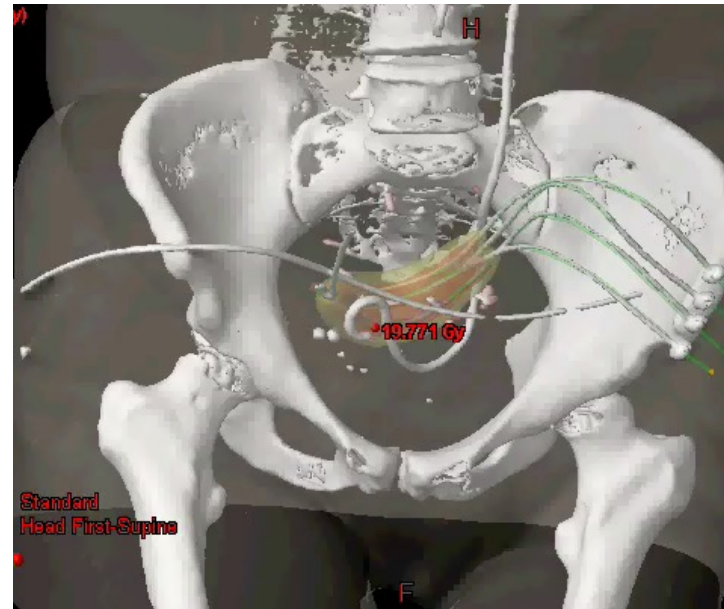
INTERDISCIPLINARY APPROACH in INTERVENTIONAL RADIOOTHERAPY



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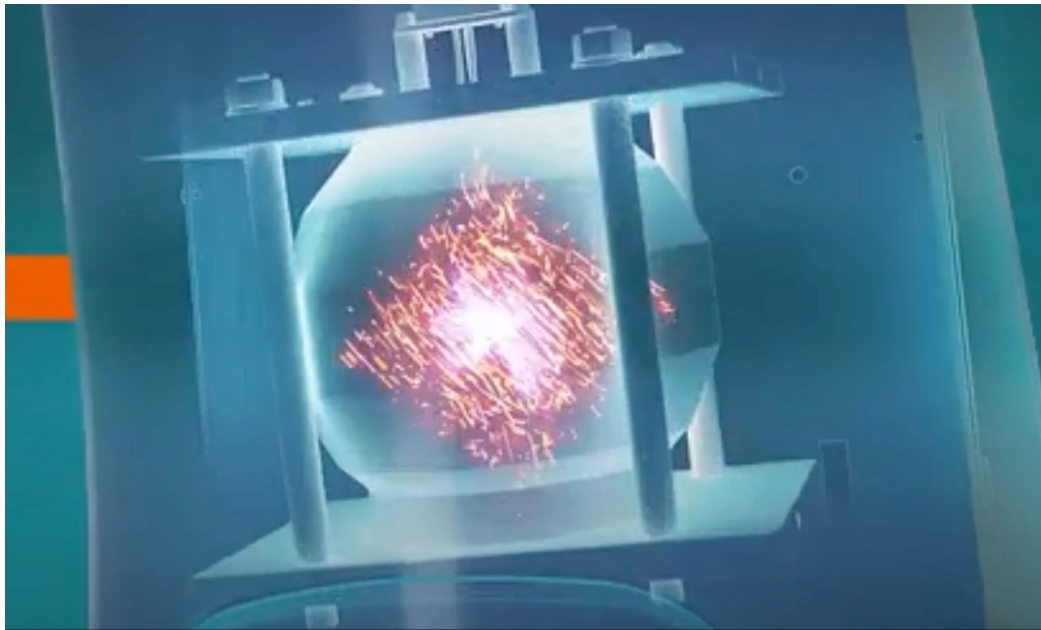


Laparoscopy Guided Procedure



from CURIETHERAPY/BRACHYTHERAPY to INTERVENTIONAL RADIOOTHERAPY ERA

INNOVATION



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AI AND OMICS GUIDED IRT



First patient
consultation

Implant

Delineation

Planning

Treatment
session
delivery

End of
treatment

Providing clinical
decision support

Mining –omics,
analysing data

Facilitating
repetitive tasks,
optimising time

Modeling
behaviors,
in heterogeneous
contexts

ARTIFICIAL INTELLIGENCE and INTERVENTIONAL RADIOOTHERAPY

Gemelli



Fondazione Policlinico Universitario Agostino Gemelli IRCCS
Università Cattolica del Sacro Cuore

ART

Advanced Radiation
Therapy

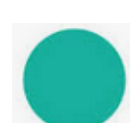
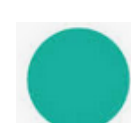
AI AND OMICS GUIDED IRT



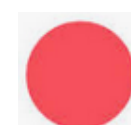
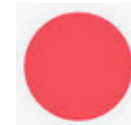
Providing clinical decision support



Mining –omics, analysing data



Facilitating repetitive tasks, optimising time



Modeling behaviors, in heterogeneous contexts



AI AND OMICS GUIDED IRT



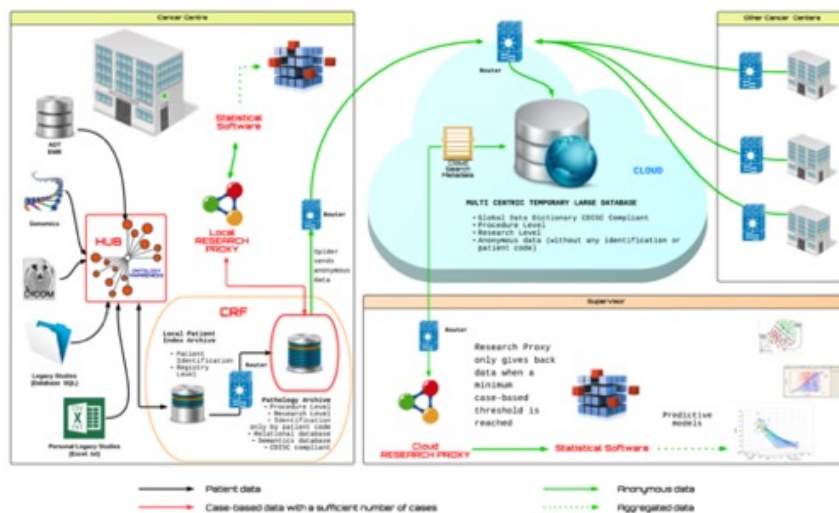
Providing clinical decision support

Mining –omics, analysing data

Facilitating repetitive tasks, optimising time

Modeling behaviors, in heterogeneous contexts

COBRA Consortium for BRachytherapy data Analysis



- Tagliaferri L, Kovács G, Autorino R, Budrukkar A, Guinot JL, Hildebrand G, Johansson B, Monge RM, Meyer JE, Niehoff P, Rovirosa A, Takácsi-Nagy Z, Dinapoli N, Lanzotti V, Damiani A, Soror T, Valentini V. ENT COBRA (Consortium for Brachytherapy Data Analysis): interdisciplinary standardized data collection system for head and neck patients treated with interventional radiotherapy (brachytherapy). *J Contemp Brachytherapy*. 2016
- Luca Tagliaferri, Monica Maria Pagliara, Carlotta Masciocchi, Andrea Scupola, Luigi Azario, Gabriela Grimaldi, Rosa Autorino, Maria Antonietta Gambacorta, Antonio Laricchiuta, Luca Boldrini, Prof. Vincenzo Valentini, Maria Antonietta Blasi. Nomogram for predicting radiation maculopathy in patients treated with Ruthenium-106 plaque brachytherapy for uveal melanoma *J Contemp Brachytherapy* 2017

AI AND OMICS GUIDED IRT

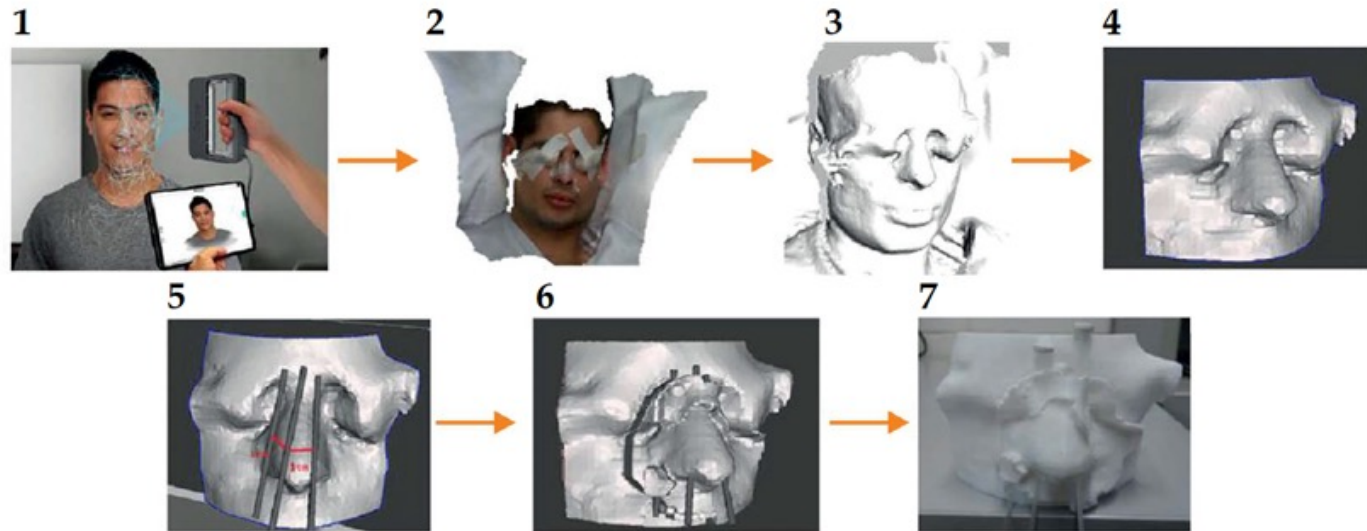


Providing clinical decision support

Mining –omics, analysing data

Facilitating repetitive tasks, optimising time

Modeling behaviors, in heterogeneous contexts



Individualized 3D scanning and printing for non-melanoma skin cancer brachytherapy

AI AND OMICS GUIDED IRT



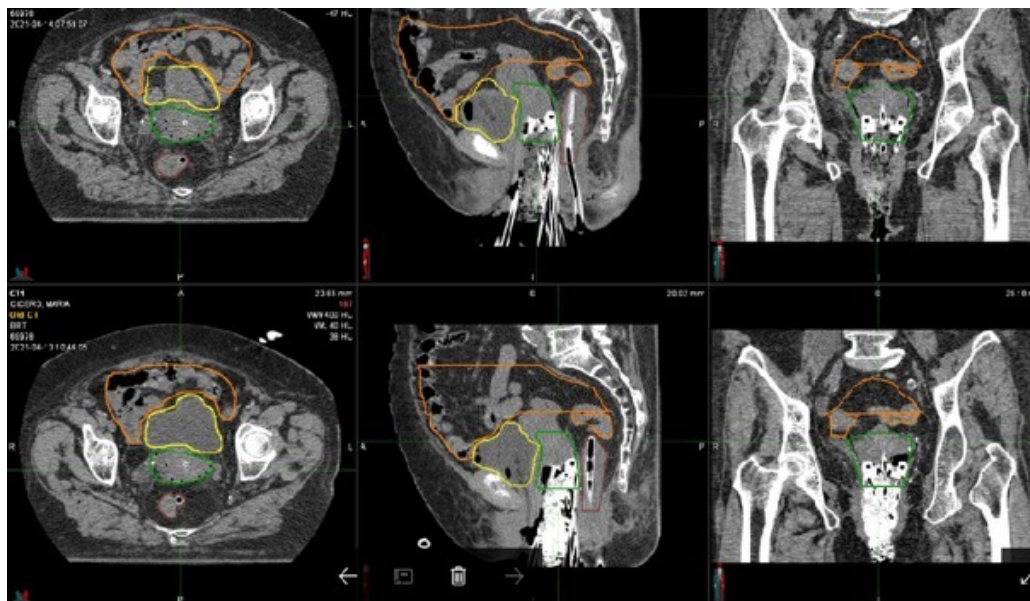
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DEEP-LEARNING AUTO-SEGMENTATION METHODS IN CERVIX CANCER



the best results were obtained for bladder segmentation.

Automatic segmentation also achieved a good result for HR-CTV and IR-CTV

The most inferior segmentation accuracies were observed on the segmentations of rectum and small bowel

AI AND OMICS GUIDED IRT



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KIT (Keep In Touch)

A mobile application

to monitor Symptoms and outcomes for cancer patients during and after treatment

- Monitoring AI driven
- Tutoring AI driven
- Chat-BOT AI based



GemelliGenerator
beyond ontology awareness

AI AND OMICS GUIDED IRT



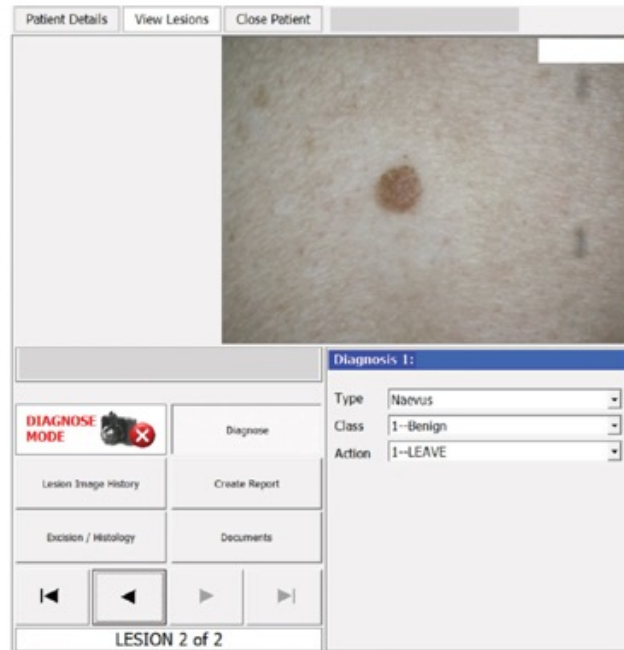
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Early detection of relapses and toxicity



BMJ Open Improving Skin cancer Management with ARTificial Intelligence (SMARTI): protocol for a preintervention/postintervention trial of an artificial intelligence system used as a diagnostic aid for skin cancer management in a specialist dermatology setting

Table 2 Management decision definitions

Management decision	Definition
Leave	Reassure patient and take no further action.
Manage—monitor	Reassessment of lesion at later time point according to Australian Guidelines.
Manage—biopsy	Partial or complete biopsy of the lesion required to confirm diagnosis.
Treat—elective	Benign or pre-cancerous lesion where treatment is not essential.
Treat—essential	Malignancy requiring non-surgical intervention.

AI AND OMICS GUIDED IRT



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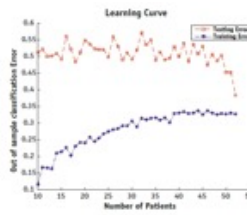
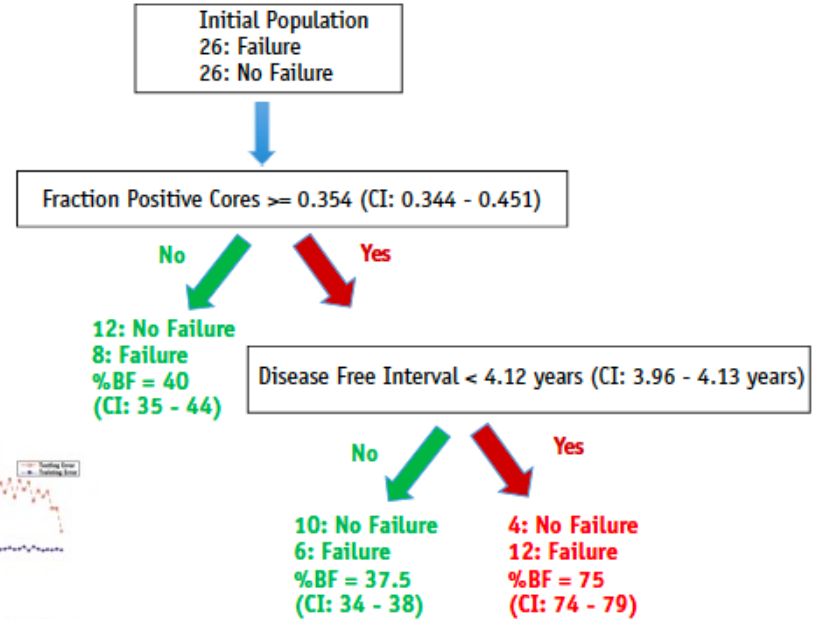
Modeling behaviors, in heterogeneous contexts

Decision Support for Salvage approach

Salvage HDR Brachytherapy: Multiple Hypothesis Testing Versus Machine Learning Analysis

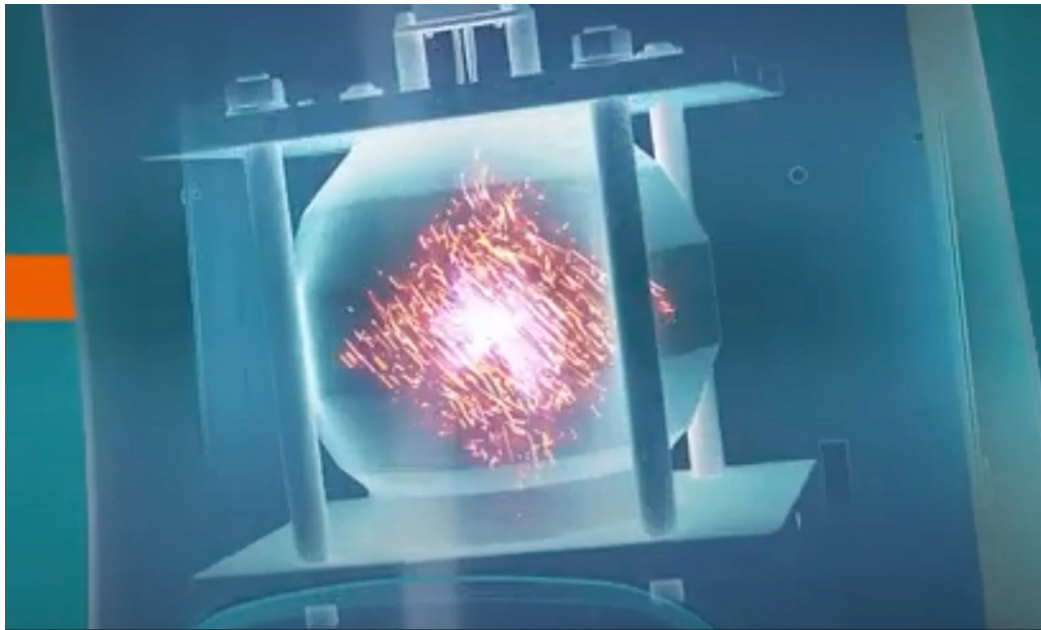
Gilmer Valdes, PhD,* Albert J. Chang, MD, PhD,* Yannet Interian, PhD,† Kenton Owen, MS,* Shane T. Jensen, PhD,† Lyle H. Ungar, PhD,‡ Adam Cunha, PhD,* Timothy D. Solberg, PhD,* and I-Chow Hsu, MD*

- identification of characteristics that can help select patients who may benefit most from sHDRB is critical
- Machine learning may be used to identify characteristics that predict outcome following sHDRB.



from CURIETHERAPY/BRACHYTHERAPY to INTERVENTIONAL RADIOETHERAPY ERA

INNOVATION



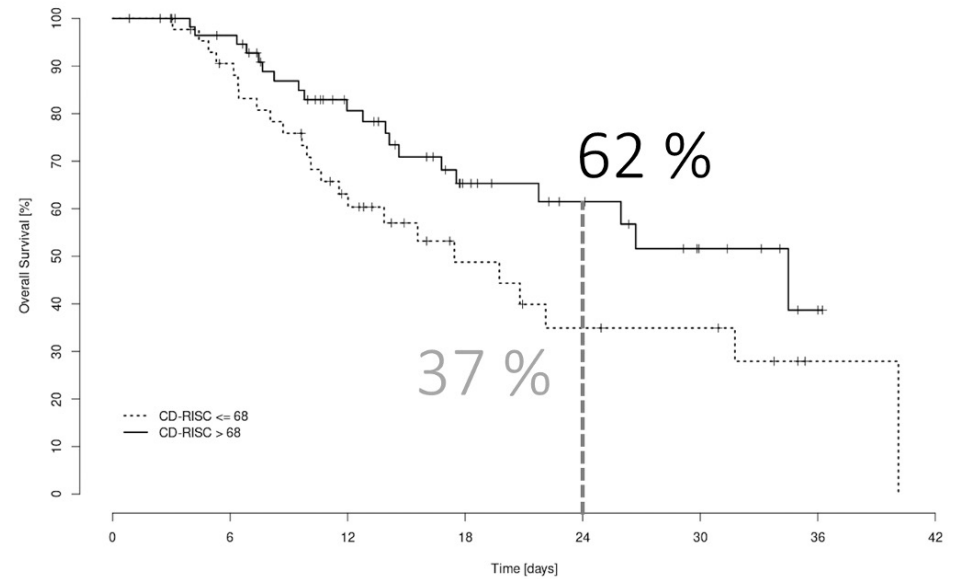
- Intensity Modulated IRT
- Image Guided IRT
- New implant procedures
- AI and Omics guided IRT

SPIRITUALITY AND RESILIENCE IN GLIOBLASTOMA

SPIRITUALITY is “a framework that provides people with a *sense of ultimate purpose and meaning in life*”

RESILIENCE is the “ability to withstand adversity and *bounce back and grow despite life’s downturns*”

- Multicentric observational protocol
- Tests: **Spirituality (FACIT-SP12); Resilience (CD-RISC).**
- 104 patients: 68 male, 36 female, median age 59.
- Median FUP was 338 days.



from CURIETHERAPY/BRACHYTHERAPY to INTERVENTIONAL RADIOTHERAPY ERA

Clinical Investigations

Original paper

HAPPY – Humanity Assurance Protocol in interventional radiotheraPY (brachytherapy) – an AIRO Interventional Radiotherapy Study Group project

Valentina Lancellotta, MD¹, Vitaliana De Sanctis, MD², Patrizia Cornacchione, MSc¹, Fernando Barbera, MD³, Vincenzo Fusco, MD⁴, Cristiana Vidali, MD⁵, Sara Scalise, MSc¹, Giulia Panza, MD⁶, Angela Tenore, MSc¹, Giuseppe Ferdinando Colloca, MD¹, Renzo Corvò, MD⁷, Maria Antonietta Gambacorta, MD⁶, Stefano Maria Magrini, MD⁸, Luca Tagliaferri, MD¹

Technical Innovations & Patient Support in Radiation Oncology 24 (2022) 101–106



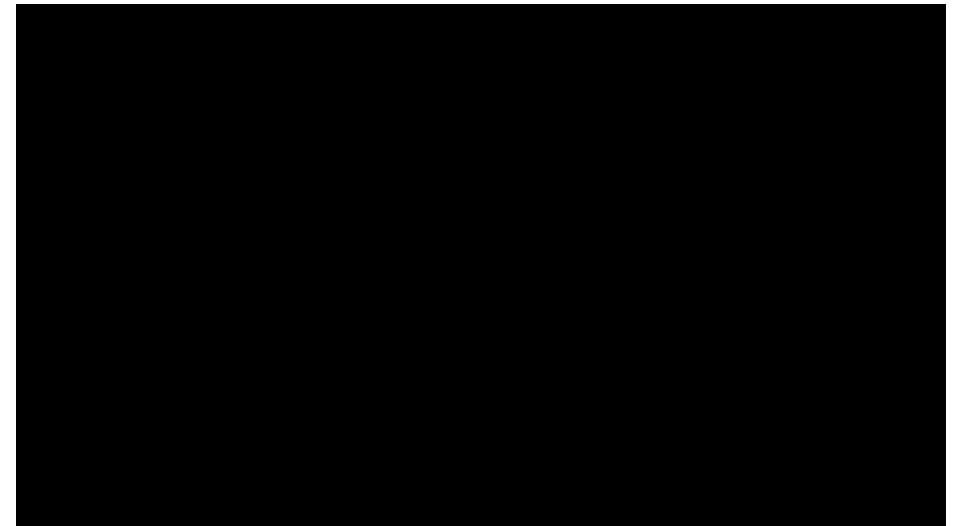
Contents lists available at ScienceDirect
Technical Innovations & Patient Support in Radiation Oncology

journal homepage: www.sciencedirect.com/journal/technical-innovations-and-patient-support-in-radiation-oncology



Art and digital technologies to support resilience during the oncological journey: The Art4ART project

Luca Tagliaferri^a, Loredana Dinapoli^{a,b}, Calogero Casà^{a,*}, Giuseppe Ferdinando Colloca^{a,c}, Fabio Marazzi^a, Patrizia Cornacchione^a, Ciro Mazzarella^a, Valeria Masiello^a, Silvia Chiesa^a, Francesco Beghella Bartoli^a, Elisa Marconi^{a,b}, Marika D'Oria^d, Alfredo Cesario^d, Daniela Pia Rosaria Chieffo^b, Vincenzo Valentini^{a,c}, Maria Antonietta Gambacorta^{a,c}

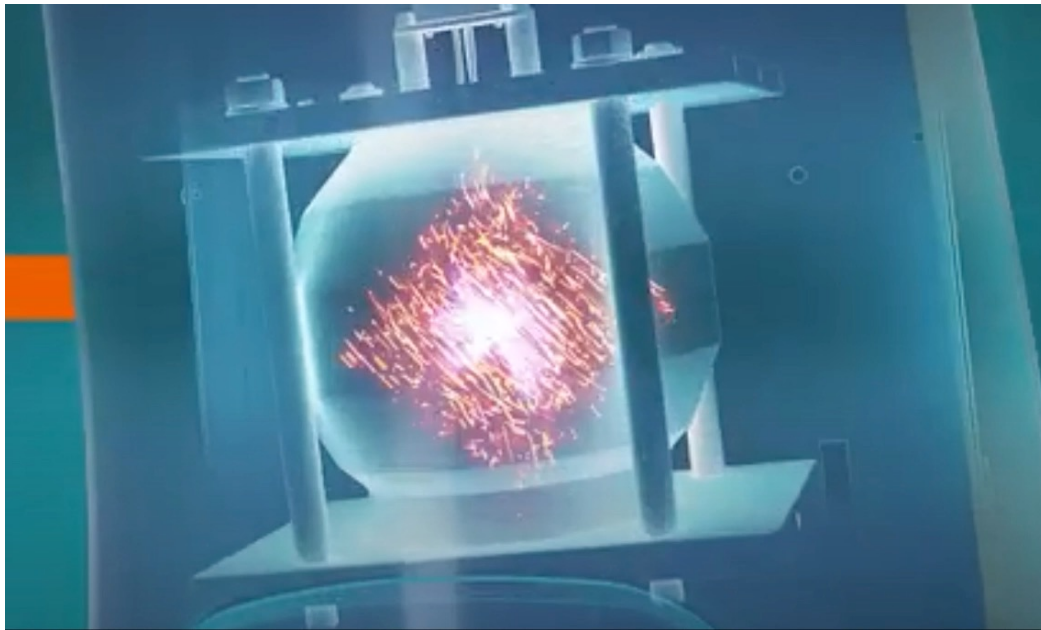


MISSION

(Mission MultiSenSory Integrated System for patient cOmpliaNce improvement)

from CURIETHERAPY/BRACHYTHERAPY to INTERVENTIONAL RADIOETHERAPY ERA

INNOVATION



- Intensity Modulated IRT
- Image Guided IRT
- New implant procedures
- AI and Omics guided IRT
- Humanist Guided IRT

Thank you
for your attention



Gemelli



Fondazione Policlinico Universitario Agostino Gemelli IRCCS
Università Cattolica del Sacro Cuore

ART
Advanced Radiation
Therapy

Interventional Radiotherapy
INTERACTS
Active Teaching School

 **IOC**
Interventional Oncology Center
Centro di Oncologia Interventistica