

1963- 50 Years of IOMP -2013



Medical physicists who have made an outstanding contribution to the advancement of medical physics over the last 50 years.



To mark the 50th Anniversary of the IOMP, national and regional medical physics organizations were invited to nominate medical physicists, and other closely related professionals, who have made an outstanding contribution to the advancement of medical physics and healthcare through research, clinical developments, education and training activities, service development, and to professional matters over the last 50 years. Whilst in most cases the contribution is of international importance, some of those selected have made such a significant contribution nationally or regionally that the international selection panel considered that they should be recognized.

Barry Allen	Penelope Allisy-Roberts	Carlos E. de Almeida	Peter R. Almond	F. Herbert Attix	Keith Boddy	Caridad Borrás	Anders Brahme	John R. Cameron	John R. Cunningham
Aaron Fenster	Maryellen L. Giger	Dietrich Harder	William R. Hendee	Yimin Hu	Godfrey Hounfield	Willi Kalender	Constantin Kappas	Kiyomitsu Kawachi	Valeriy Kostylev
Anjali Krtanachinda	Tomas Kron	Lawrence H. Lanzl	John S. Laughlin	Paul C. Lauterbur	C. Clifton Ung	John Mallard	Jim Malone	Peter Mansfield	Sören Mattsson
Charles A. Mistretta	Kwan-Hoong Ng	Fridtjof Nüsslin	Colin G. Orton	Jose Perez-Calatayud	Ervin B. Podgorsak	Ambika Sahai Pradhan	Madan M. Rehani	David W.G. Rogers	Jean-Claude Rosenwald
Wolfgang Rubenau	Tae Suk Suh	Hans Tetsch	Enchi Terasaki	David Thwaites	Gianpietro Tuzi	David W. Townsend	Jacob Van Riel	Steve Webb	Peter Wells



La Física Médica en Radioterapia: Ambito y Retos

Jose Perez-Calatayud

Hospital Universitario y Politecnico La Fe. Valencia

Clínica Benidorm. Benidorm

perez_jos@gva.es

Real Academia Medicina de la Comunidad Valenciana

19 Junio 2014

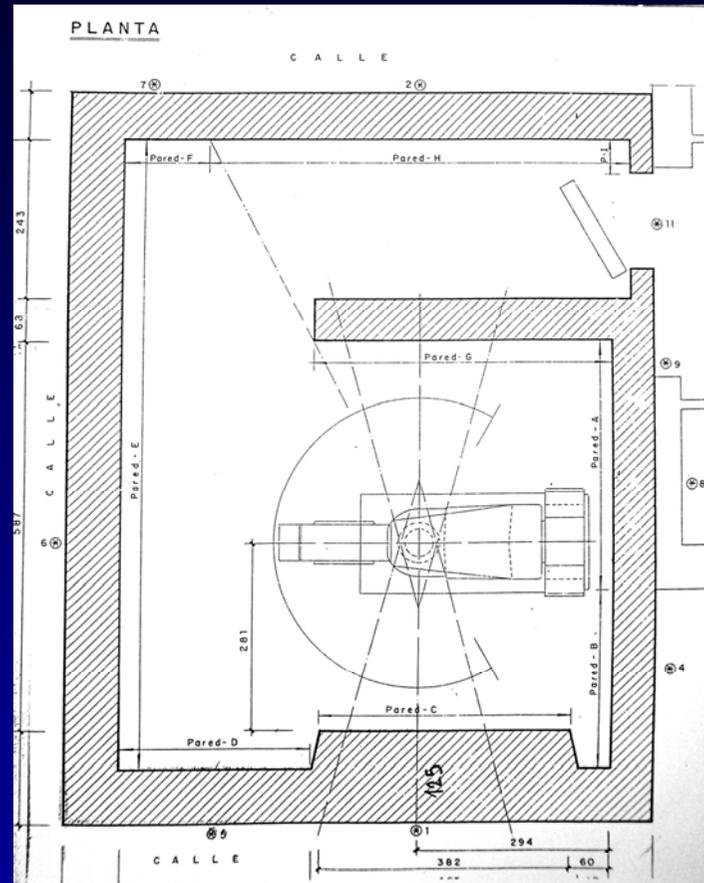
Contenido

- Radiofísica Hospitalaria
- Radiofísica en Radioterapia
- Oncología Radioterápica: Modalidades y Proceso
- Retos
- Evolución tecnológica
- Aportaciones de la CV

Radiofísica en el Hospital

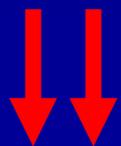
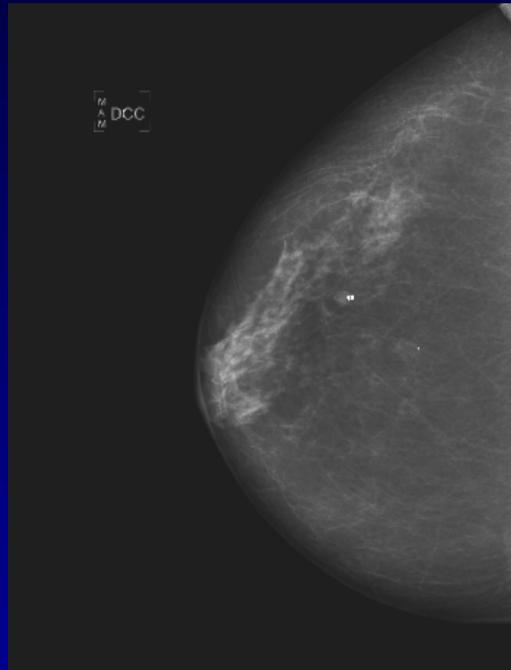
Protección Radiológica

- PR Personal PPE, paciente, público
- Diseño Reglamentos
- Diseño Blindajes
- Dosimetría personal / ambiental
- Gestión Residuos
- CSN



As Low As Reasonably Achievable

- Control calidad equipos RX
- Calidad de Imagen
- PACS
-

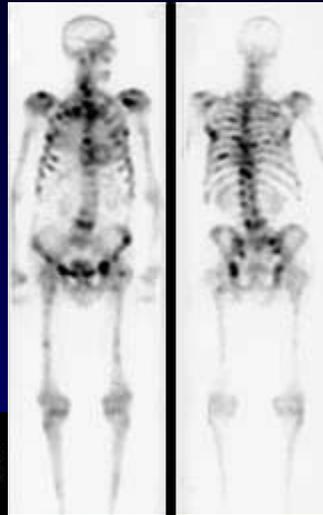
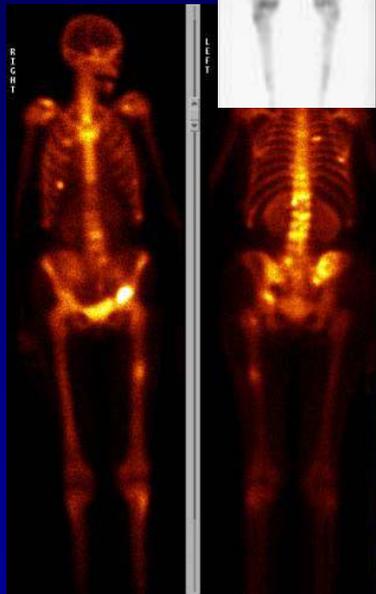
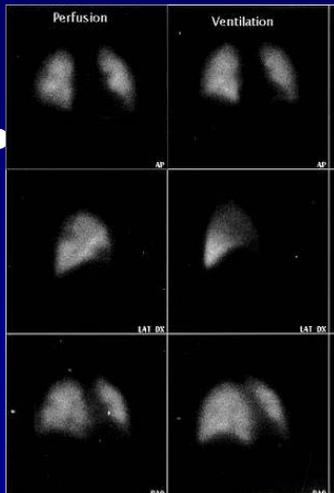


DOSIS = Calidad de Imagen requerida por el Radiologo

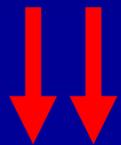
ALARA

Radiofísica en el Hospital

- Control calidad equipos MN
- Calidad de Imagen
- Residuos



M. Nuclear



DOSIS



Calidad de Imagen requerida por el diagnóstico

ALARA



Formación Radiofísica Hospitalara

FER



Formación paralela MIR

Protección Radiológica



0.5

Radiodiagnóstico



0.5

Medicina Nuclear y otros
usos de las radiaciones



0.5

Radioterapia



1.5

3 años

En proyecto 4

Funciones Físico Médico o Radiofísico en Radioterapia

Dosimetría física

ERI Equipos tto-planificación

Garantía Calidad-PCP

Aceptación-Supervisión IT

PR paciente en RT

Dosimetría clínica

Eficiencia proceso RT

Colaboración ORT en plan

Optimización-Calculo-Verificación

Garantia Calidad

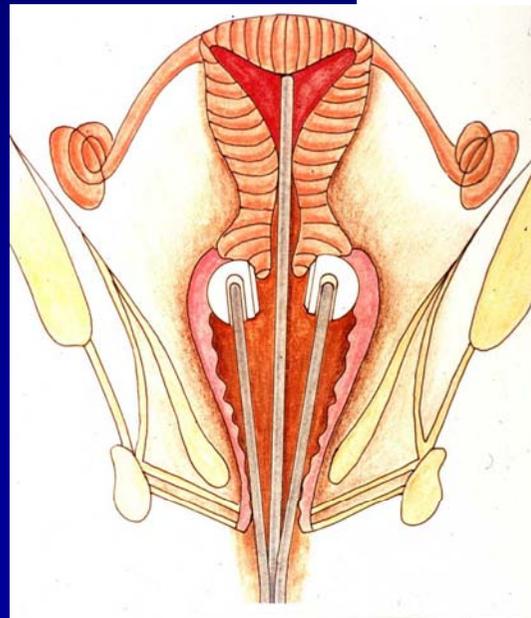
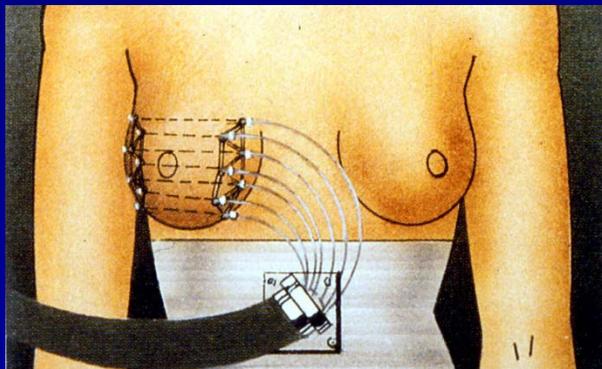
Actualización-Investigación



Tipos RT

TELETERAPIA

BRAQUITERAPIA





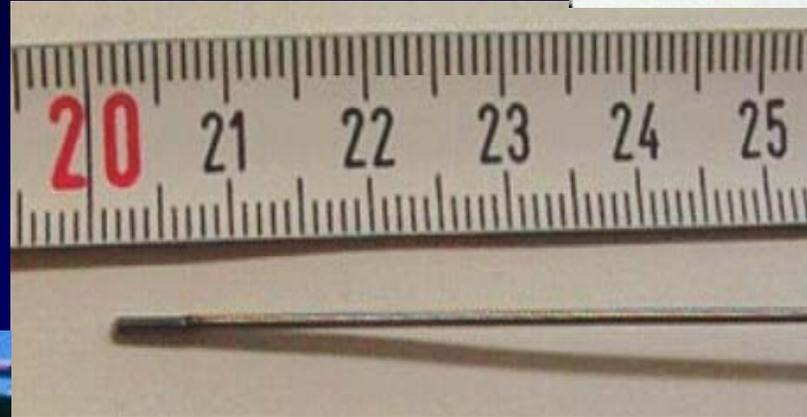
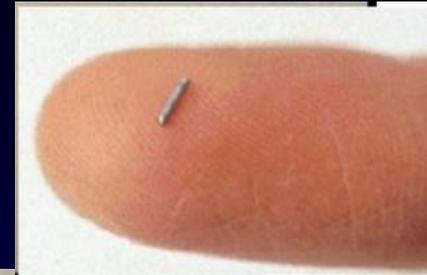
Braquiterapia

Fuentes HDR

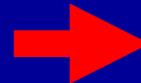
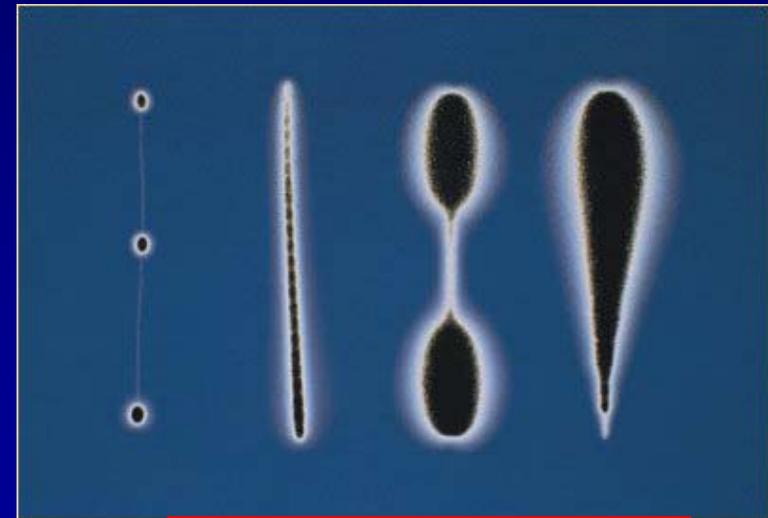
Ir-192

Co-60

γ



La fuente, muy activa, viaja según tiempos y posiciones programadas

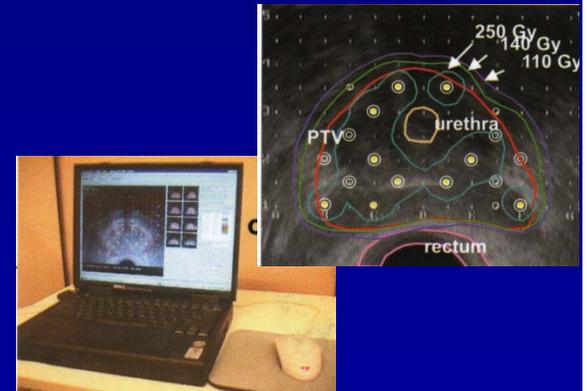
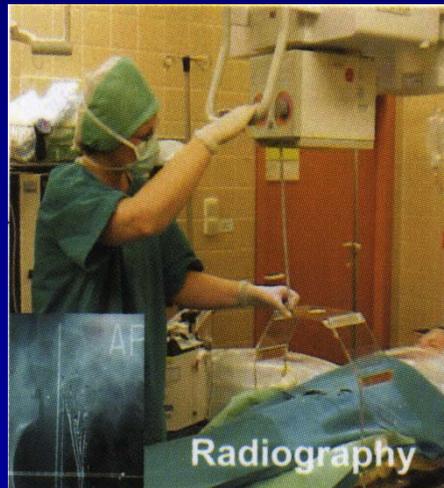
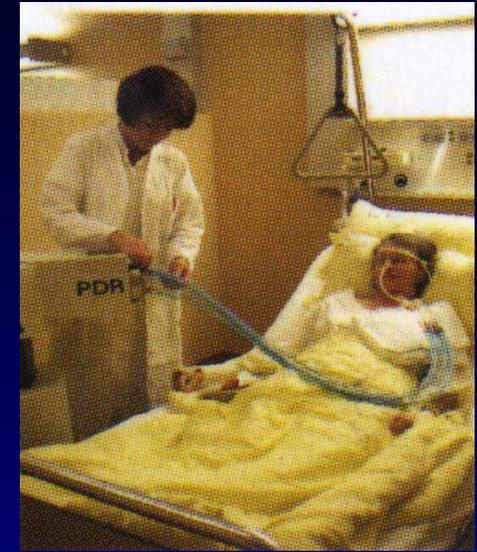


OPTIMIZACIÓN

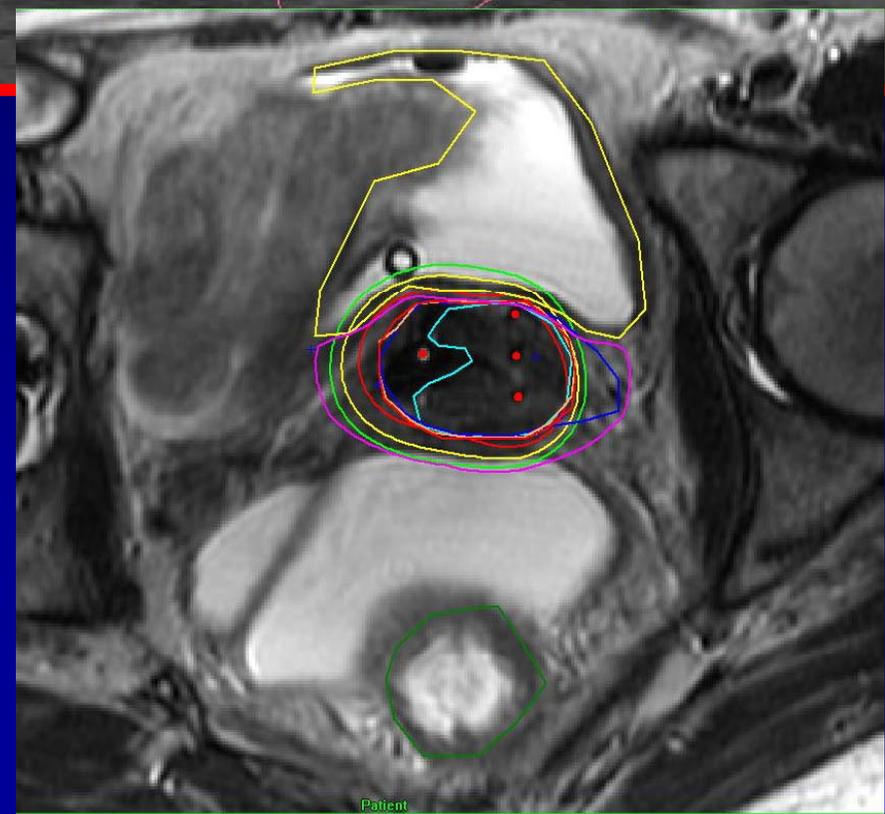
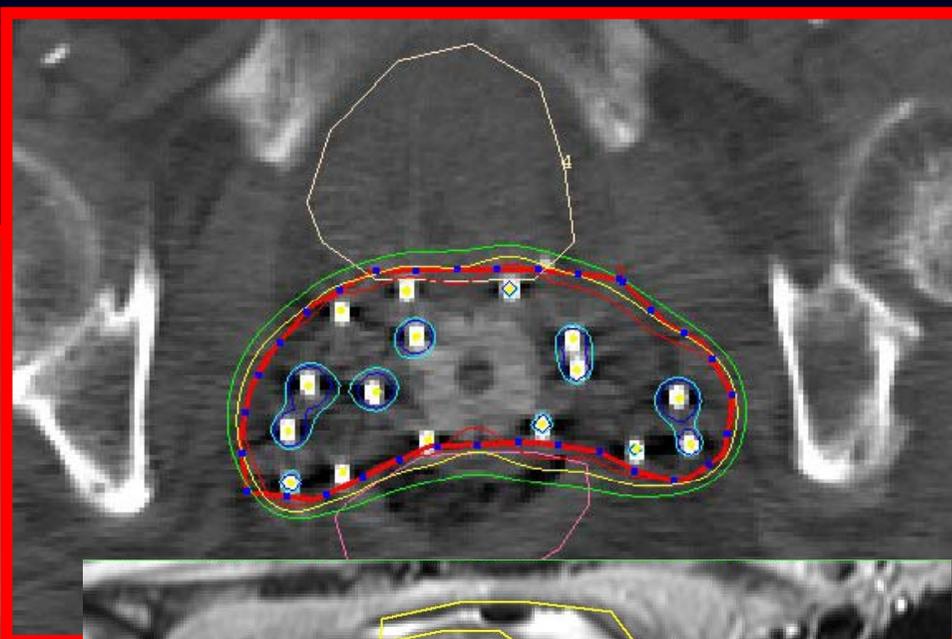
Braquiterapia



Proceso planificación-
tratamiento
BT diferida

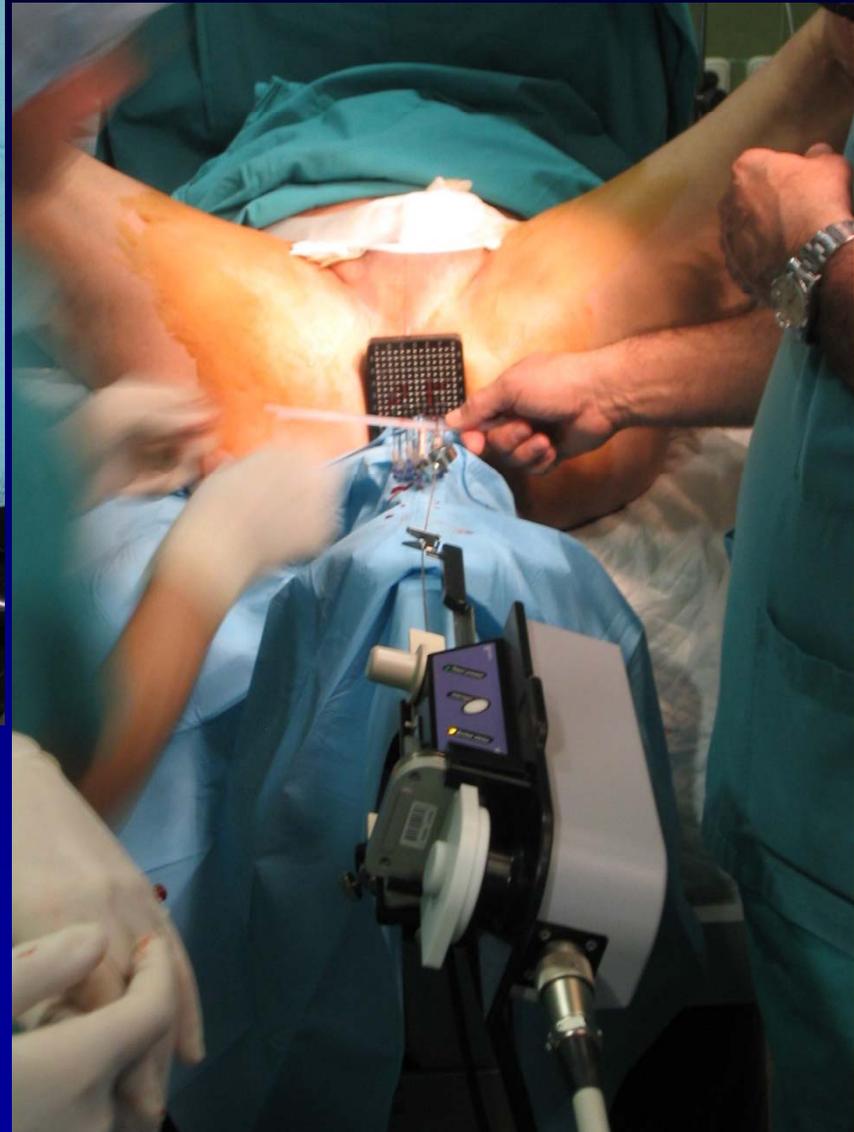


CT & MR



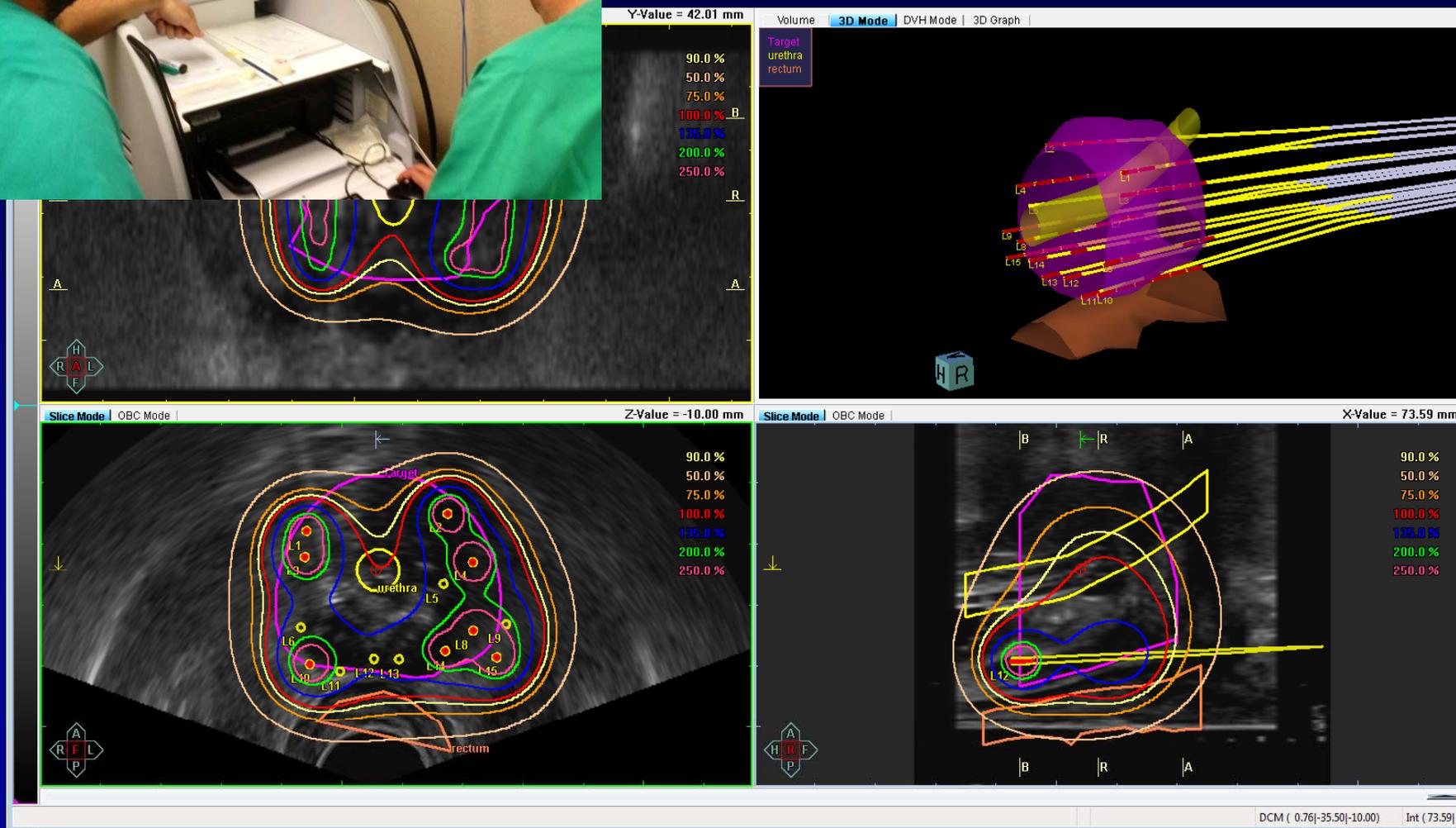
Implantes permanentes I-125

Inserción guiada ecográficamente
Planificación + Implante en mismo acto



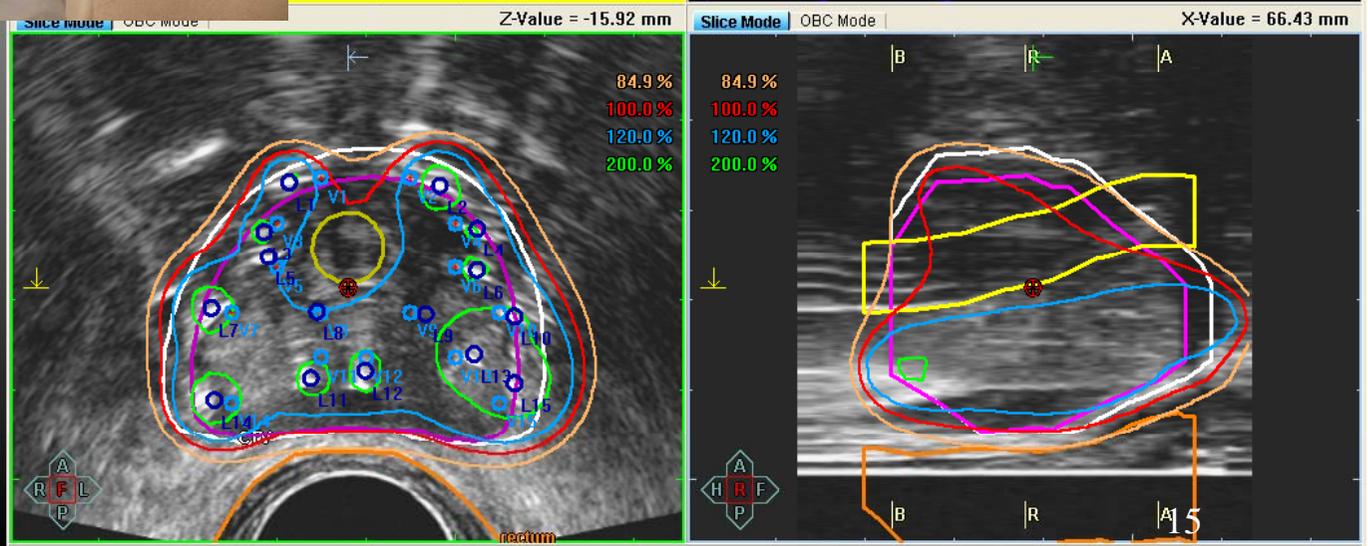
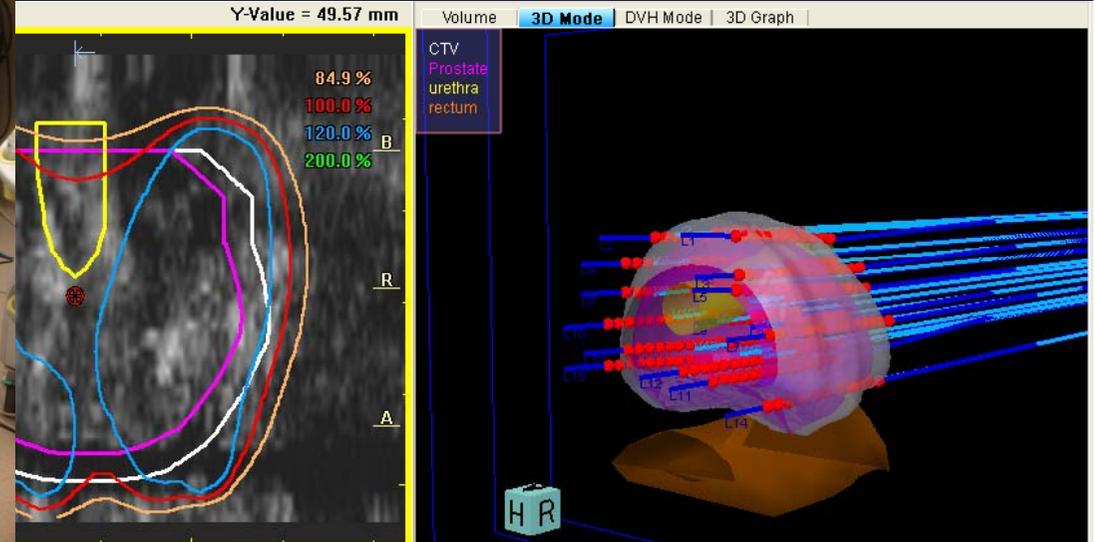


Colaboración ORT



Braquiterapia HDR

Inserción guiada ecográficamente Planificación + Implante en mismo acto



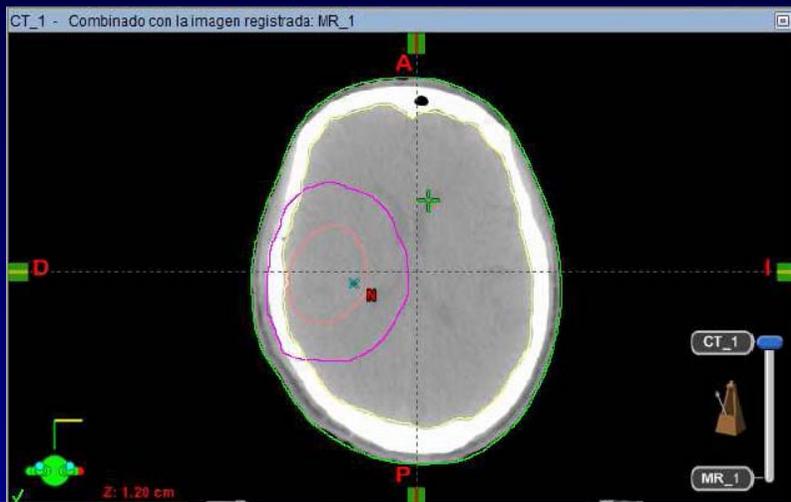
Combinada con
RT Externa



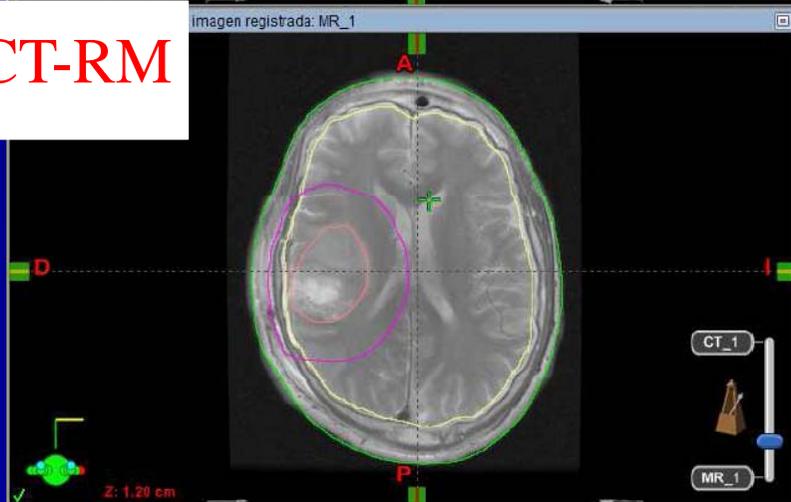
RT Externa o Teleterapia



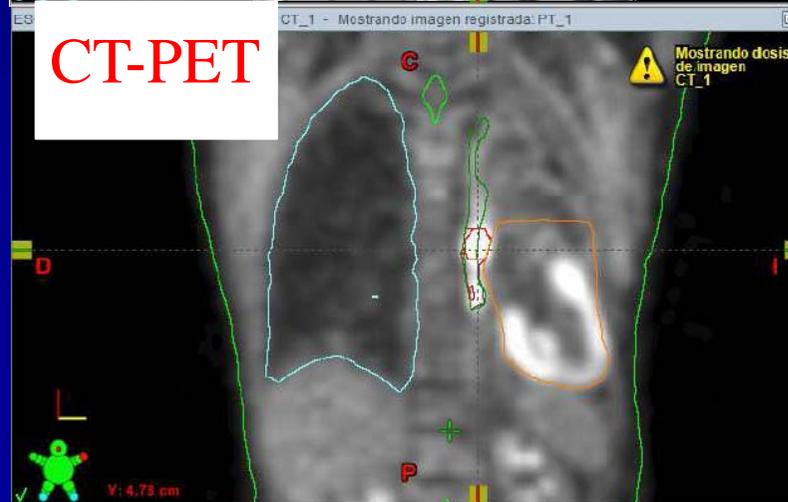
Contorneo



CT-RM



CT-PET





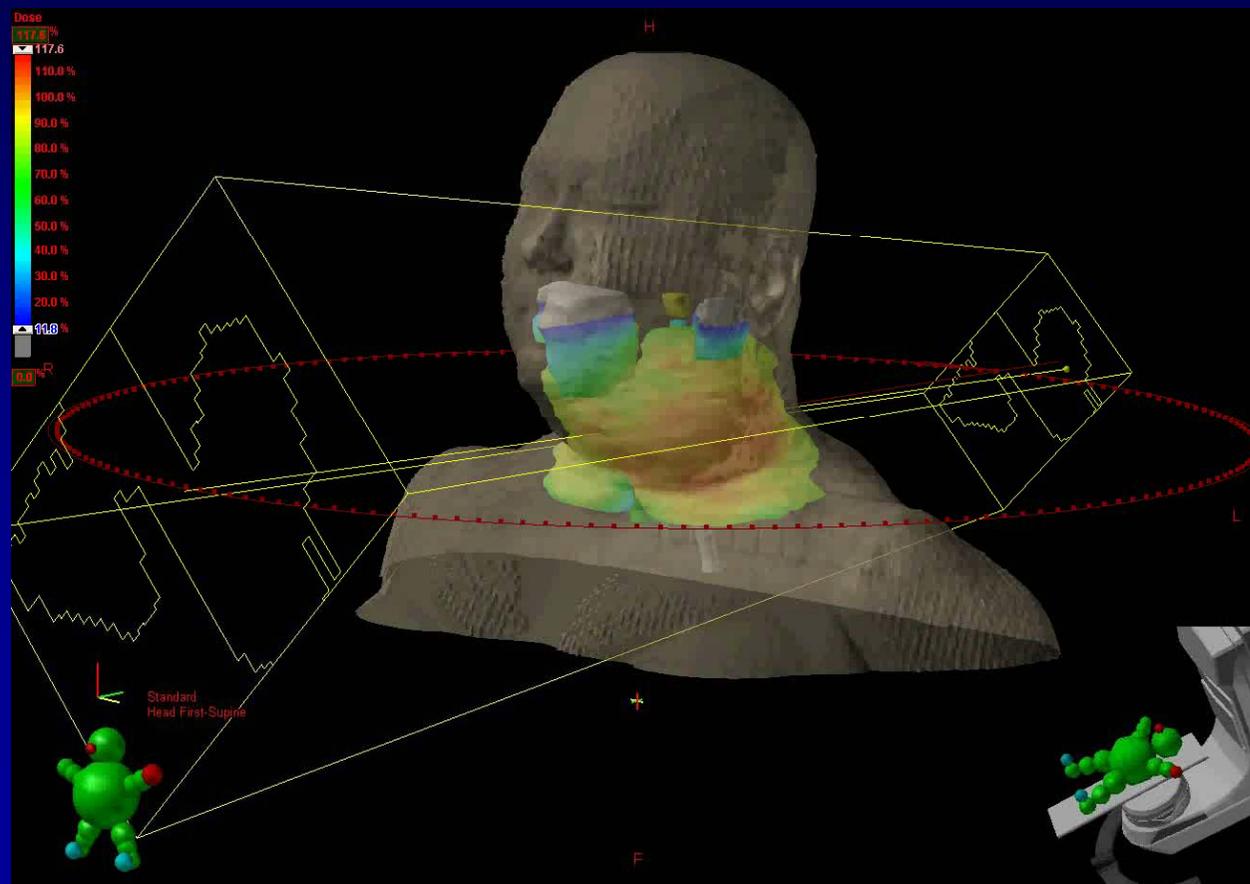
IMRT VMAT



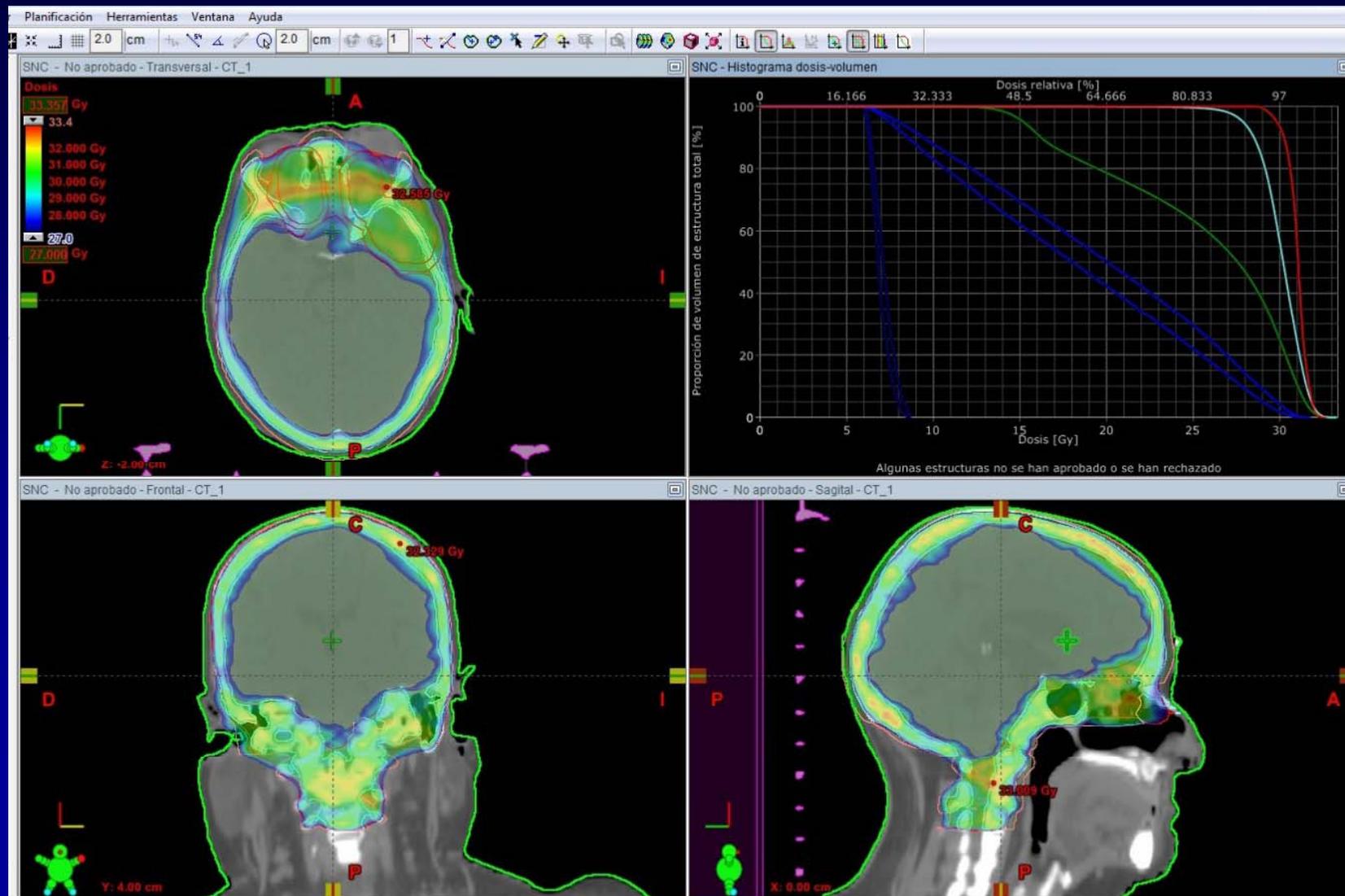
Optimización + Planificación + Verificación



QA proceso y Unidades



IMRT



IMRT + SBRT



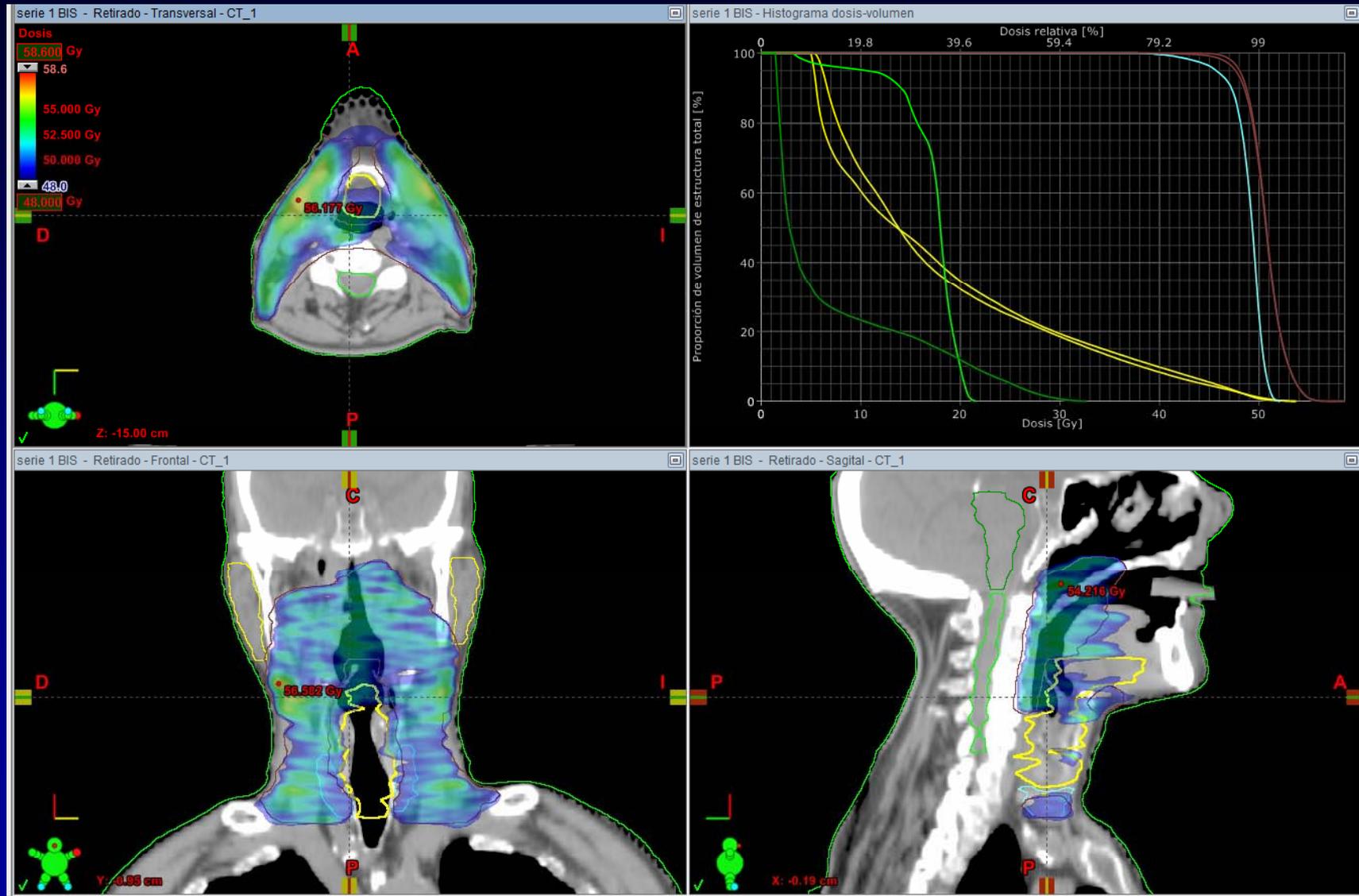
Holocraneal

RA



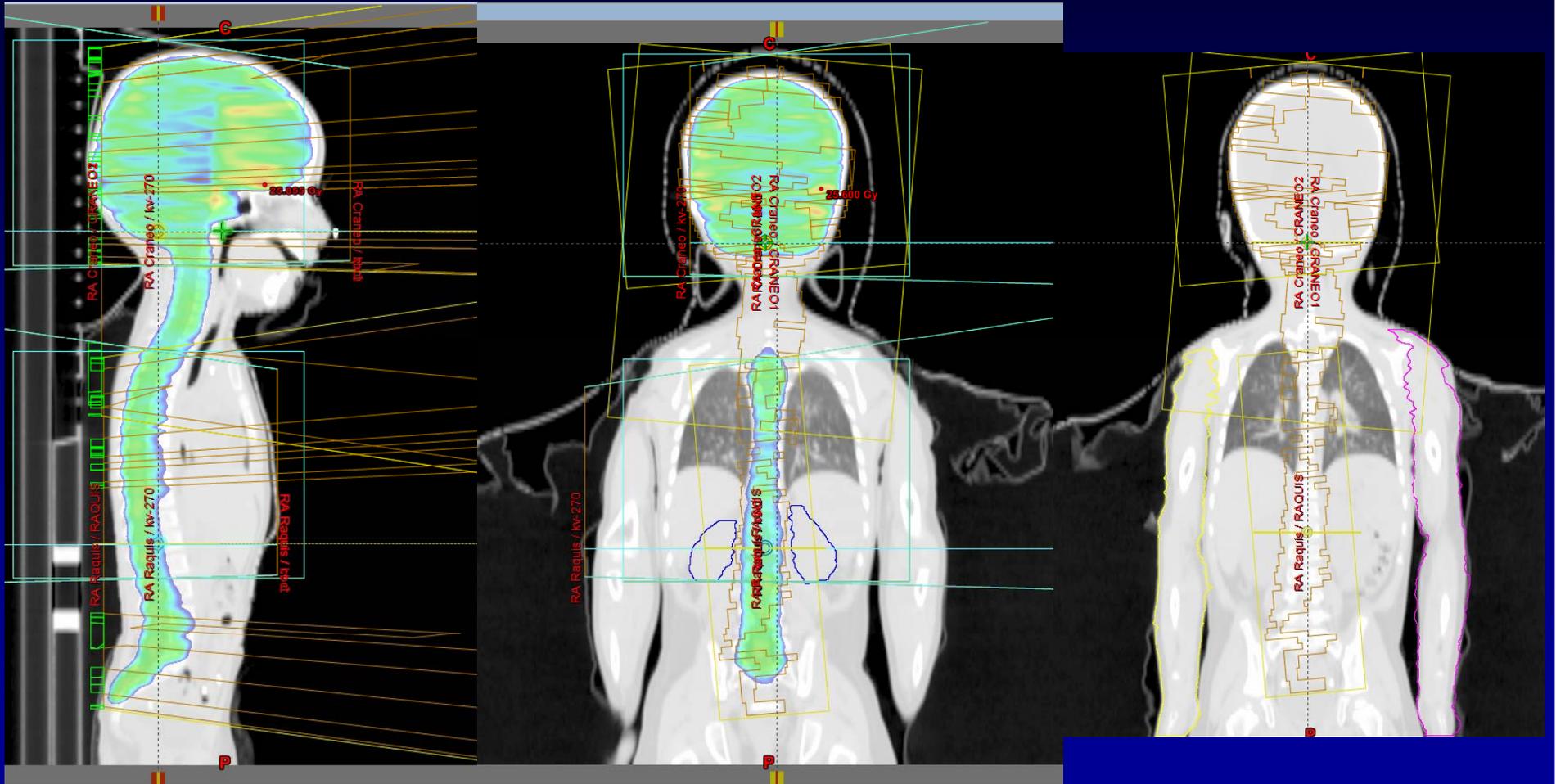
ORL

RA



Craneoespinal

RA

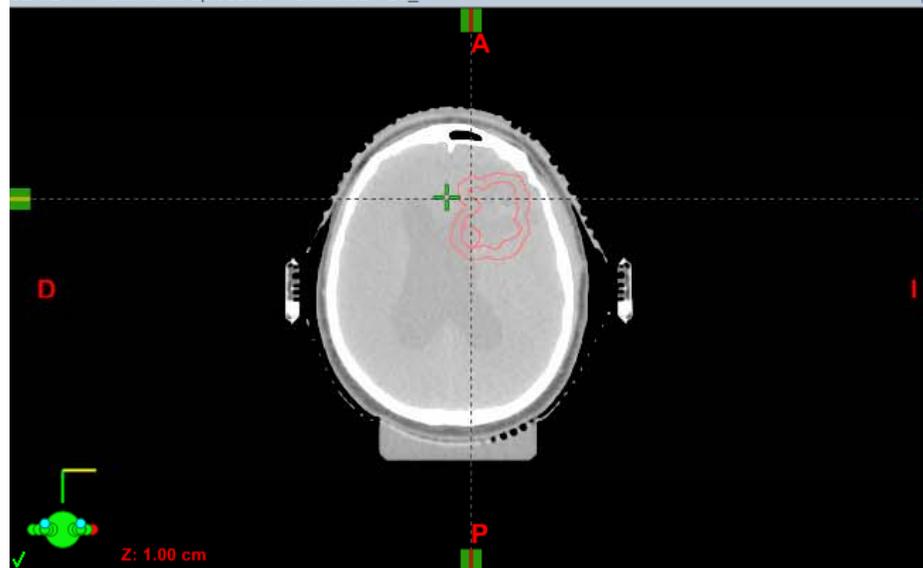


Campos	Prescripción de dosis	<input type="checkbox"/> Alineaciones de campo	<input type="checkbox"/> Objetivos del plan	<input type="checkbox"/> Objetivos de optimización	Estadísticas de dosis	Modelos de cálculo	Plan suma			
Plan	Tipo	Color	Estructura	Límite	Vol [%]	[Gy]	Prioridad			
RA Craneo	Punto		BRAZO DCHO	Superior	0.00	5.000	50			
RA Craneo	Punto		BRAZO IZDO	Superior	0.00	5.000	50			

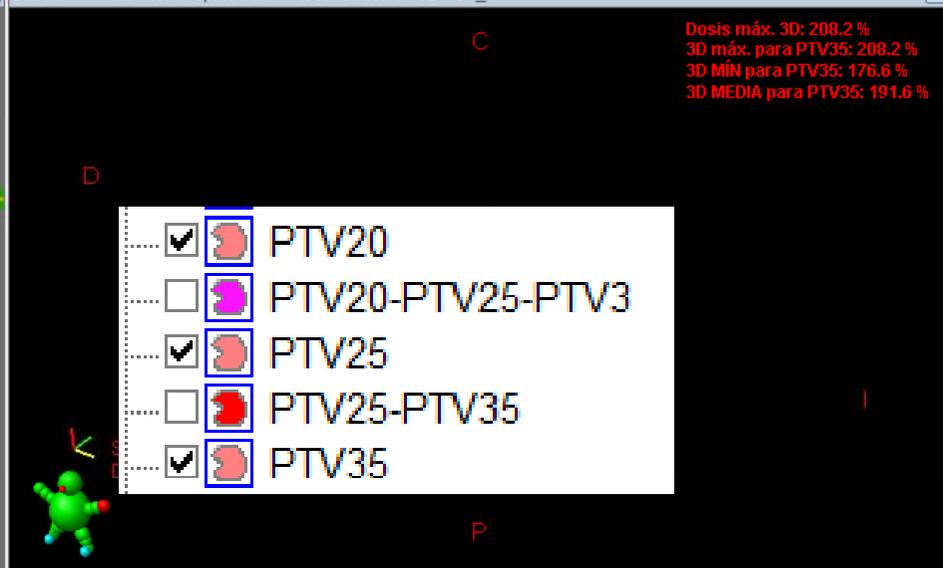
SBRT cerebral FFF

RA

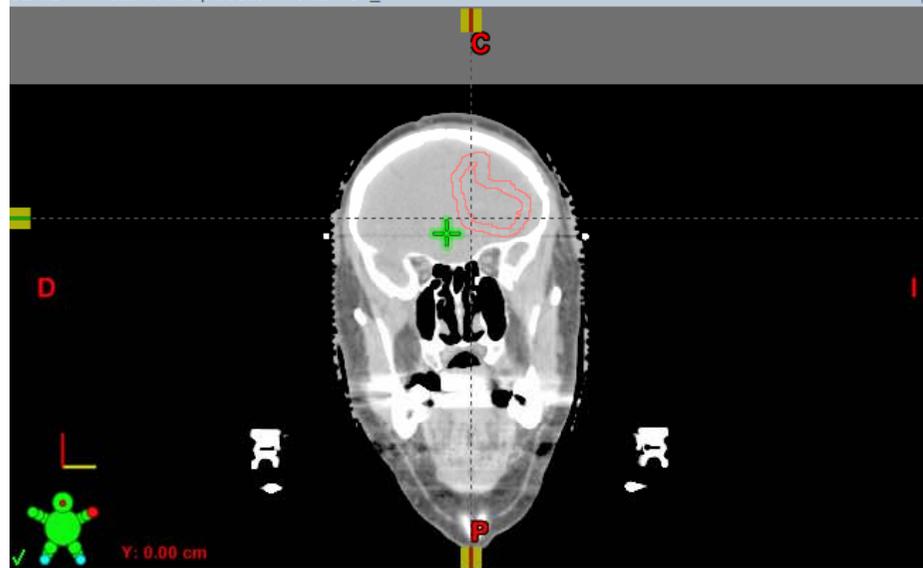
SERIE1 - Tratamiento aprobado - Transversal - CT_1



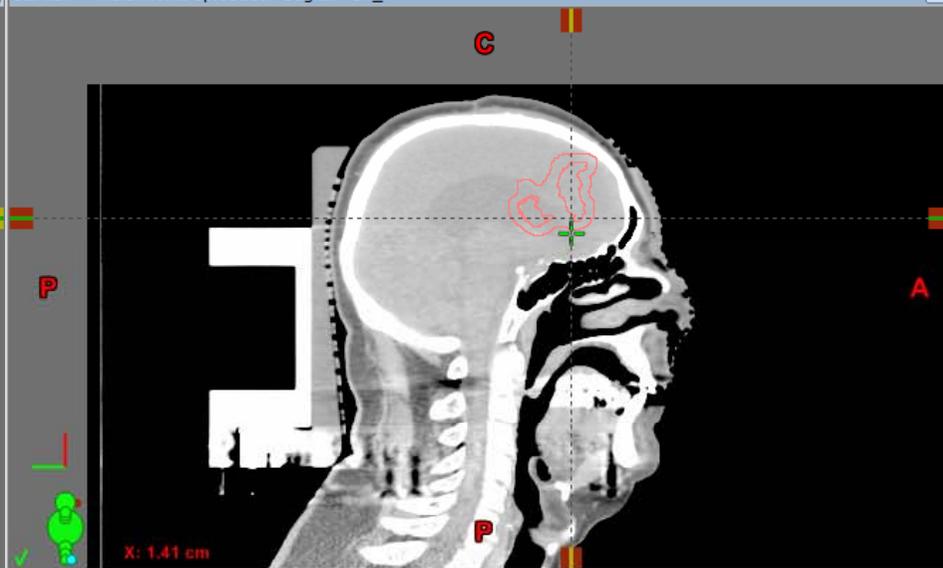
SERIE1 - Tratamiento aprobado - Reconstrucción 3D - CT_1



SERIE1 - Tratamiento aprobado - Frontal - CT_1



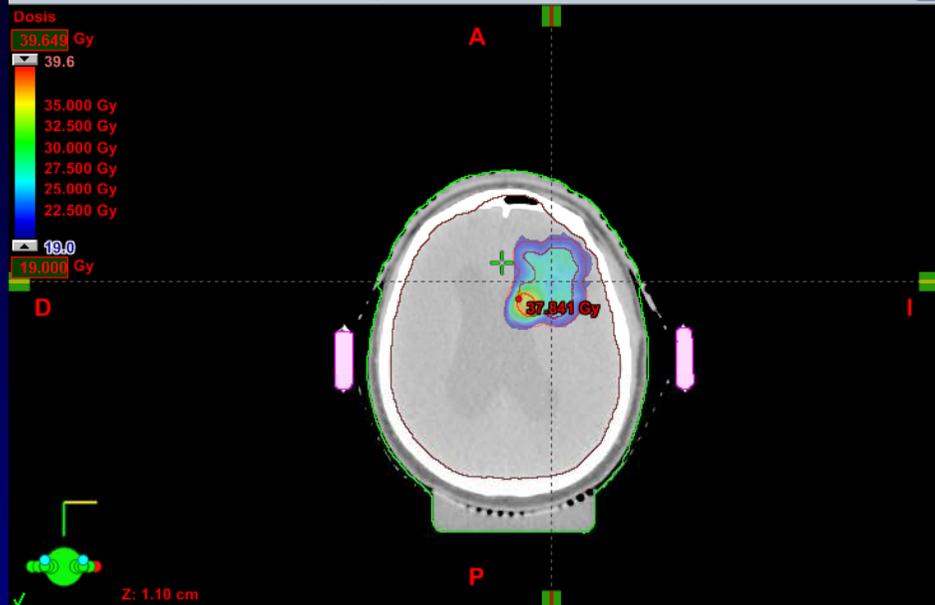
SERIE1 - Tratamiento aprobado - Sagital - CT_1



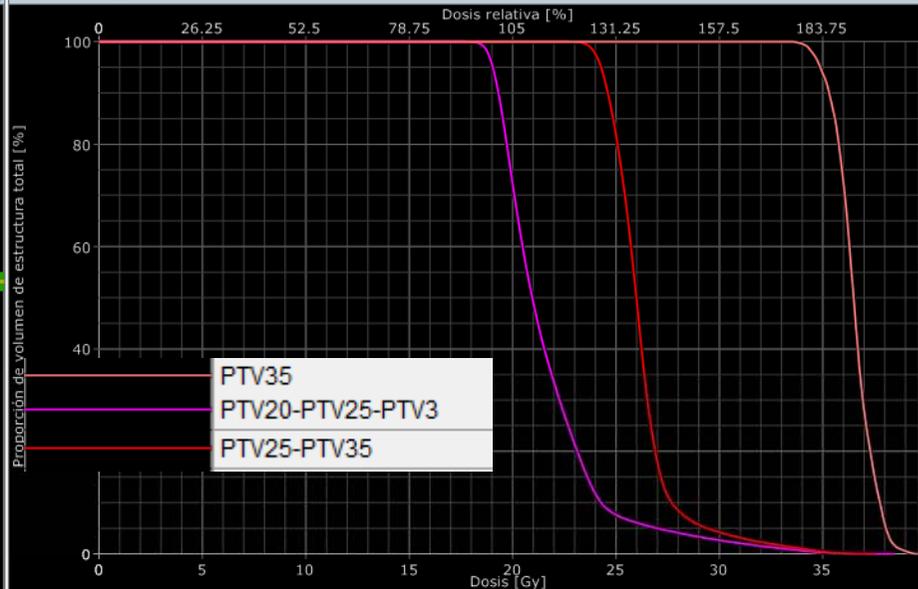
SBRT cerebral FFF

RA

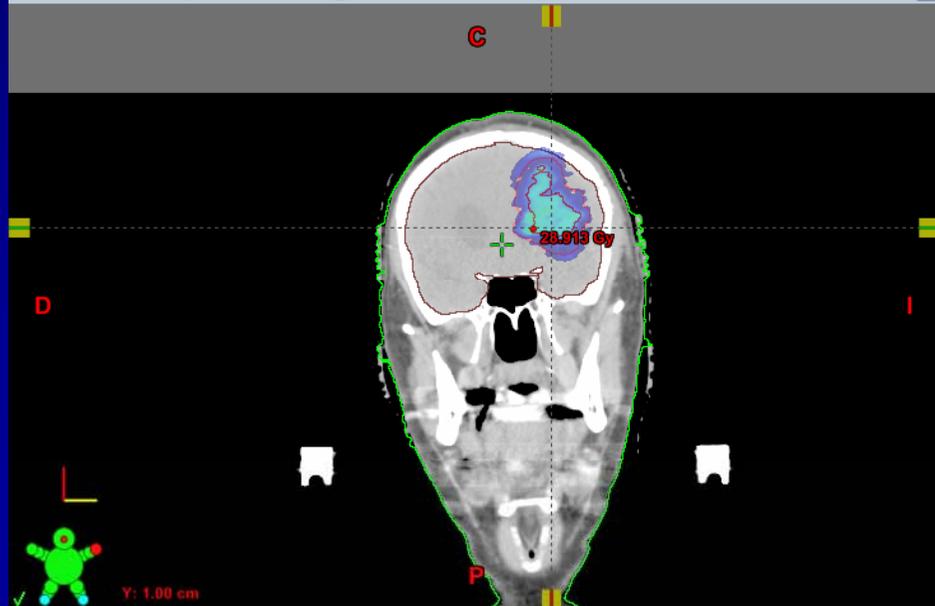
SERIE1 - Tratamiento aprobado - Transversal - CT_1



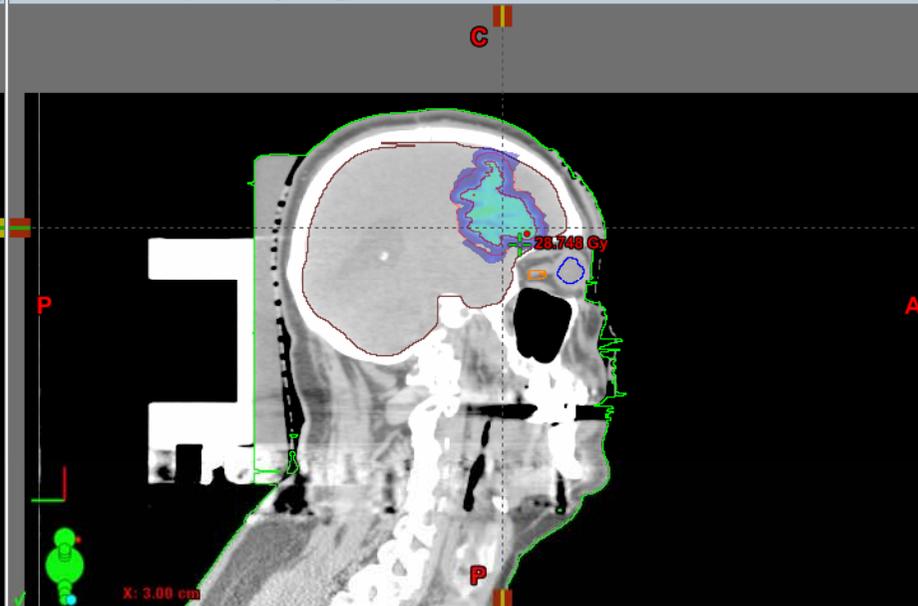
SERIE1 - Histograma dosis-volumen



SERIE1 - Tratamiento aprobado - Frontal - CT_1

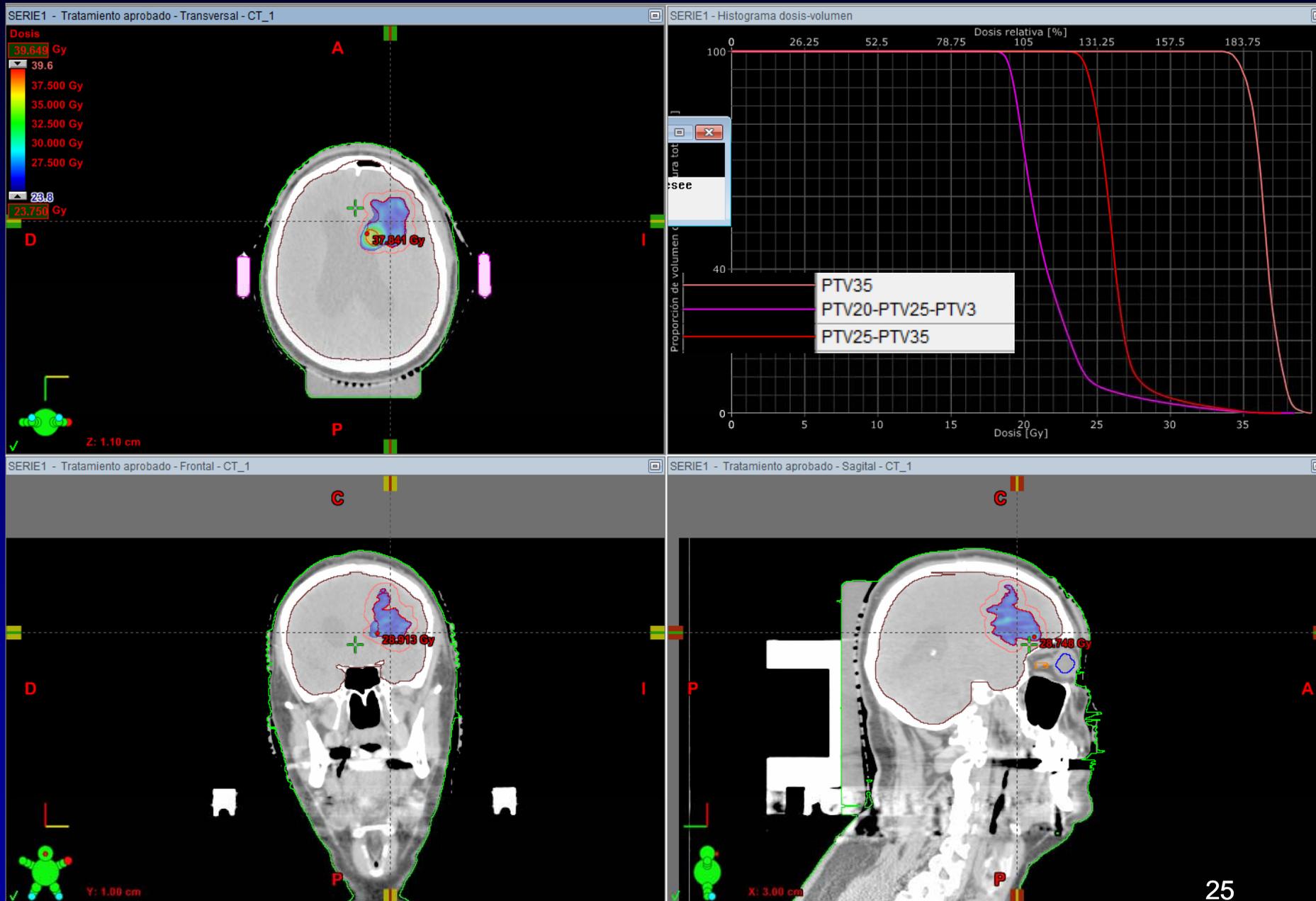


SERIE1 - Tratamiento aprobado - Sagital - CT_1



SBRT cerebral FFF

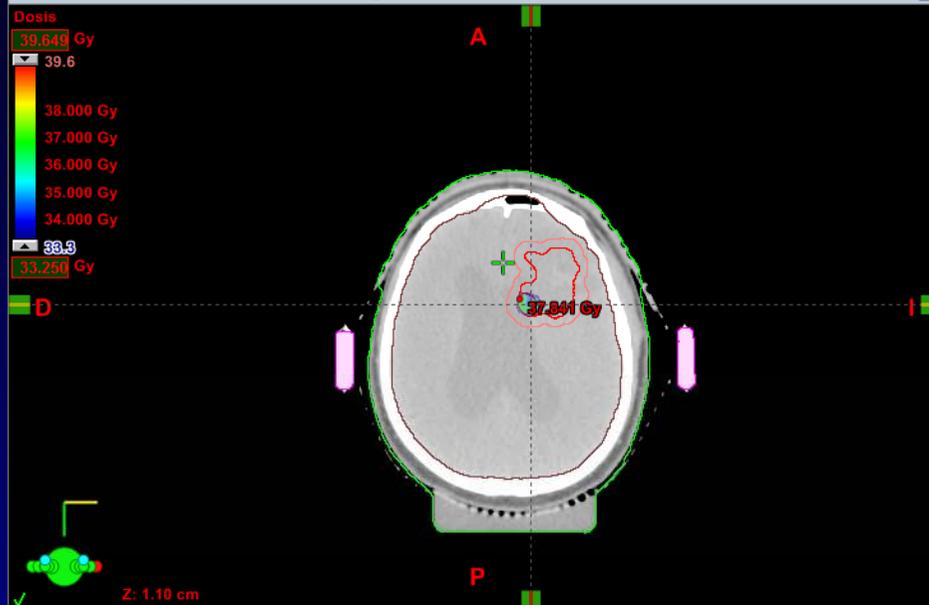
RA



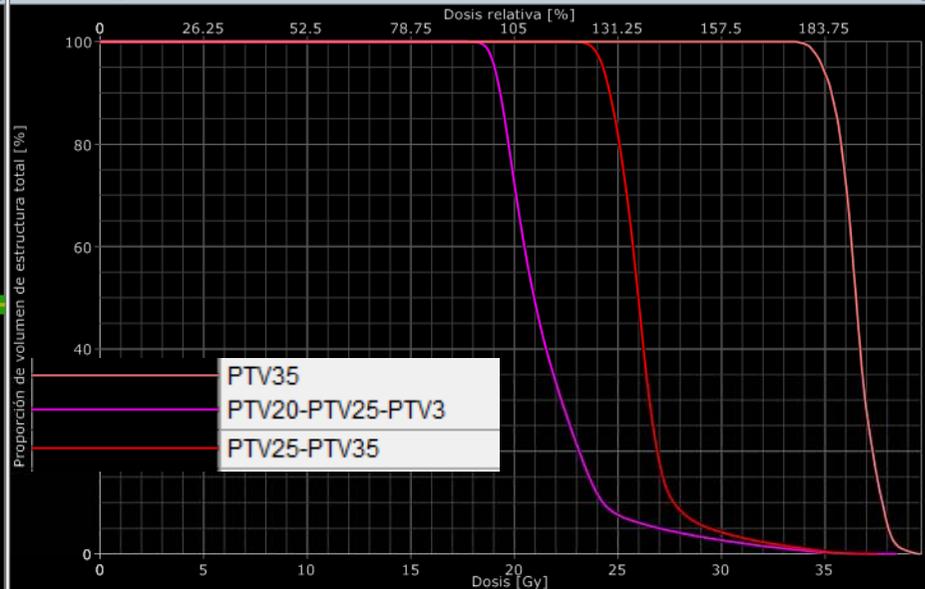
SBRT cerebral FFF

RA

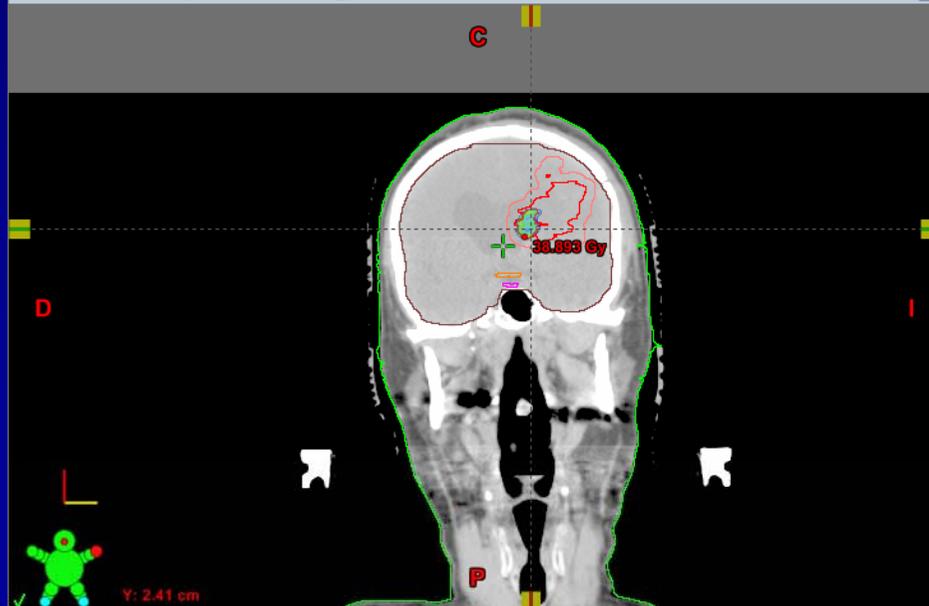
SERIE1 - Tratamiento aprobado - Transversal - CT_1



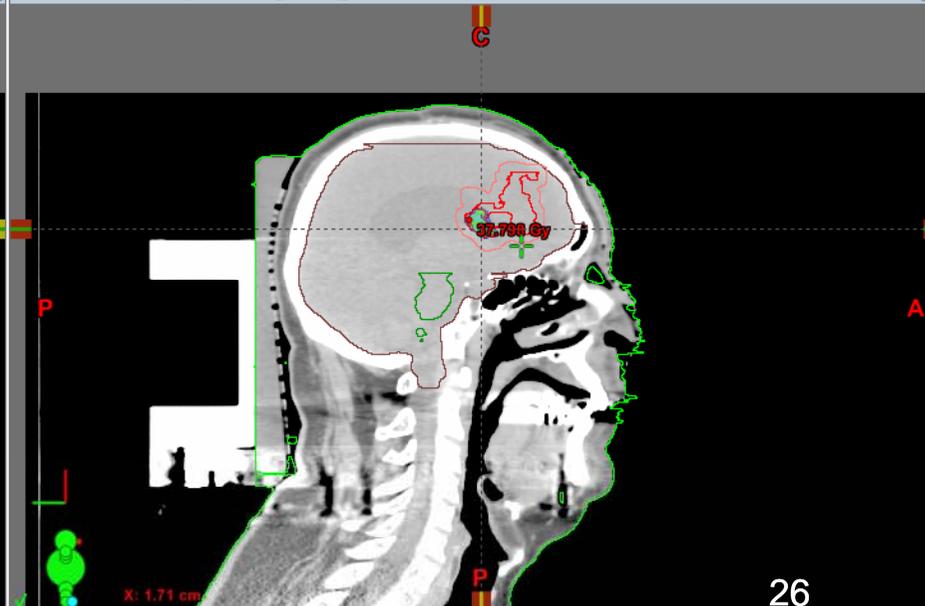
SERIE1 - Histograma dosis-volumen



SERIE1 - Tratamiento aprobado - Frontal - CT_1



SERIE1 - Tratamiento aprobado - Sagital - CT_1





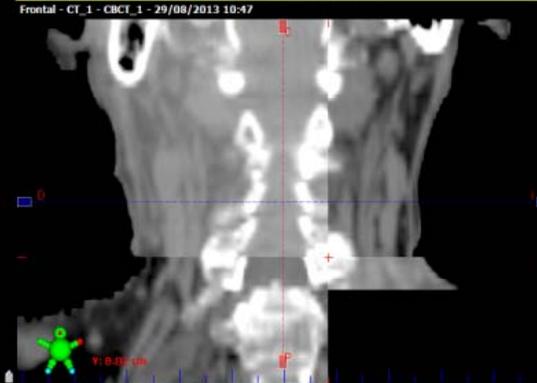
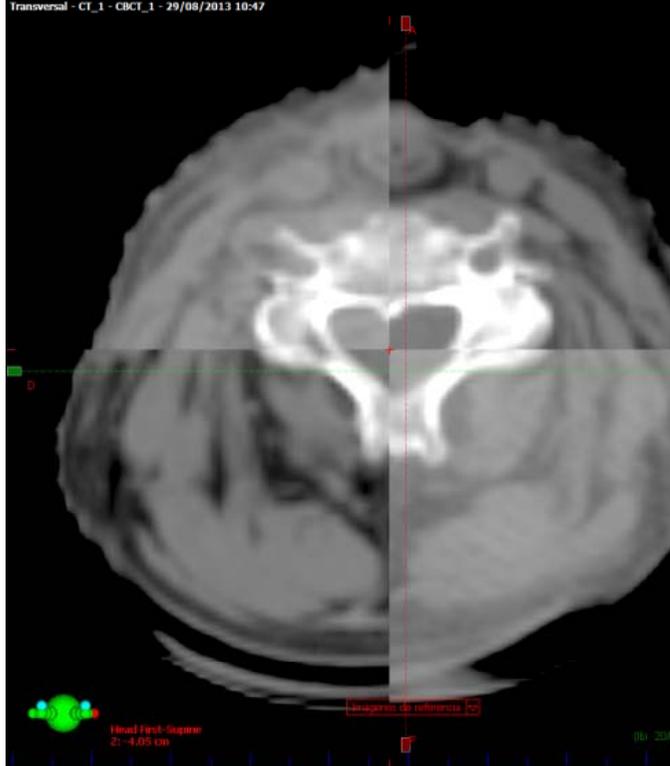
IGRT

Sistemas de Imagen incorporados al Acelerador





IGRT



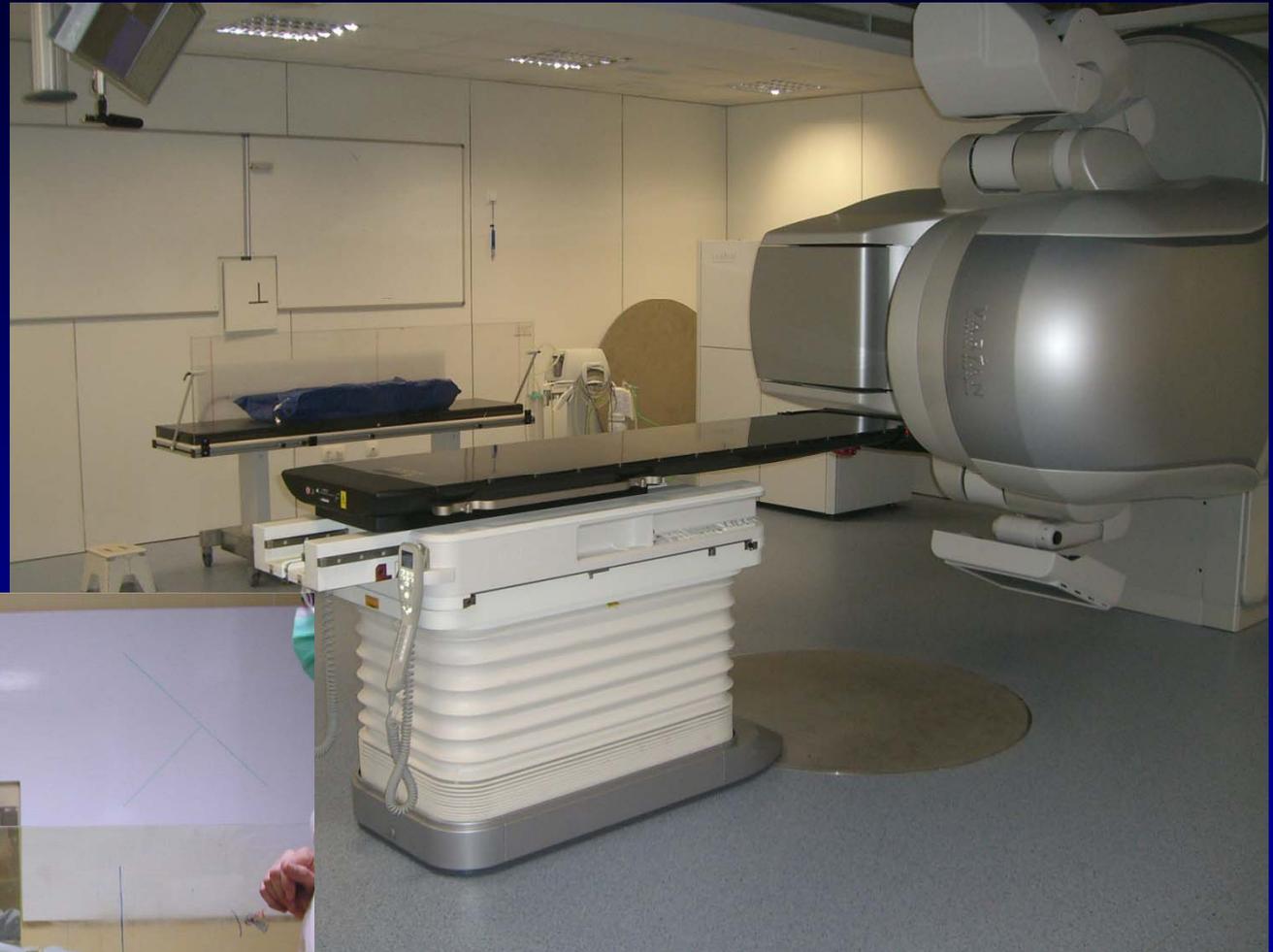
*Herramientas
comparación en
consola*



Tecnicas Especiales

TBI

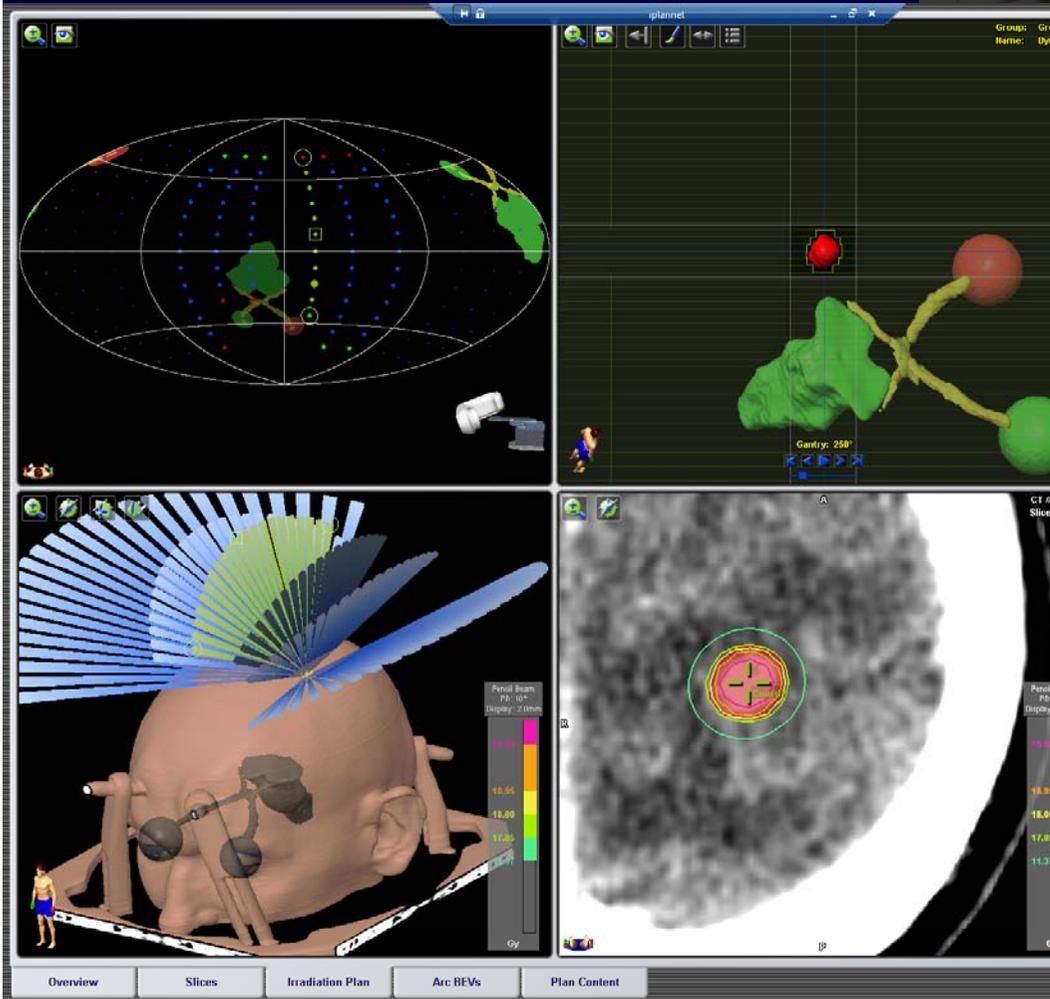
Tratamiento habitual
en TrueBeam





Técnicas Especiales

Radiocirugía



Radiocirugia MAV

Overview | Slices | Field Reconstructions | X-ray Images | Setup DRRs | Plan Content

BrainLAB
iPlan RT Dose 4.1

Radiocirugia Neuralgia Trigemino

Navigator

NEURALGIA_V2.DER.FUSIONeistomedic...

Physician's Review

Load Plan

Go to... Next

Functions **POI**

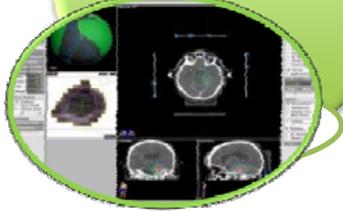
Trigeminal Nerve, Right	PTV
Brainstem	OAR 3
Chiasm	OAR 3
Eye, Left	OAR 3
Eye, Right	OAR 3
Hippocampus, Right	OAR 3
Optic Nerve, Left	OAR 3
Optic Nerve, Right	OAR 3
Tissue	
Normal Tissue	

Plan Approval

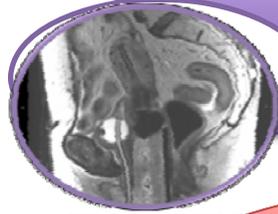
Overview Slices DVH / Reconstructions Plan Content

BrainLAB
iPlan RT Dose 4.1

NEUROCIRUGÍA



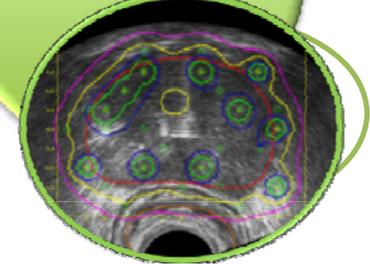
RADIOLOGÍA



CIRUGÍA



UROLOGÍA



RADIOFÍSICA

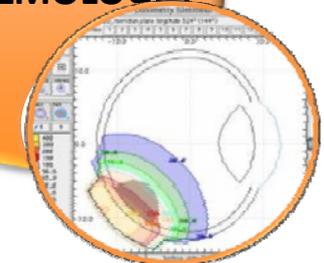


**ONCOLOGÍA
RADIOTERÁPICA**

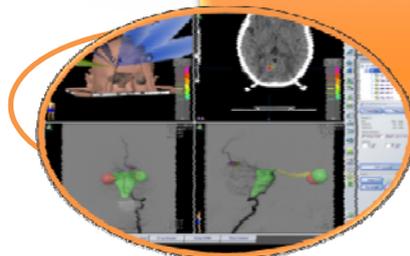
DERMATOLOGÍA



OFTALMOLOGÍA



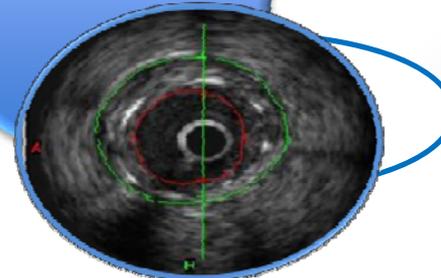
**NEURO-
RADIOLOGÍA**



NEUMOLOGÍA



CARDIOLOGÍA

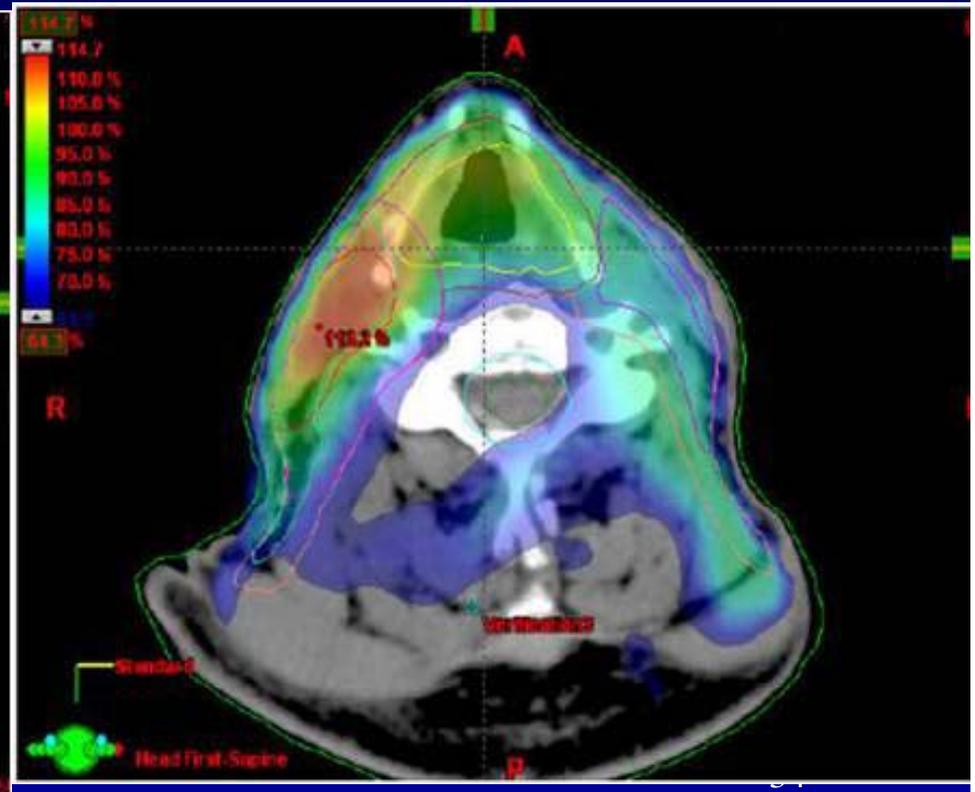
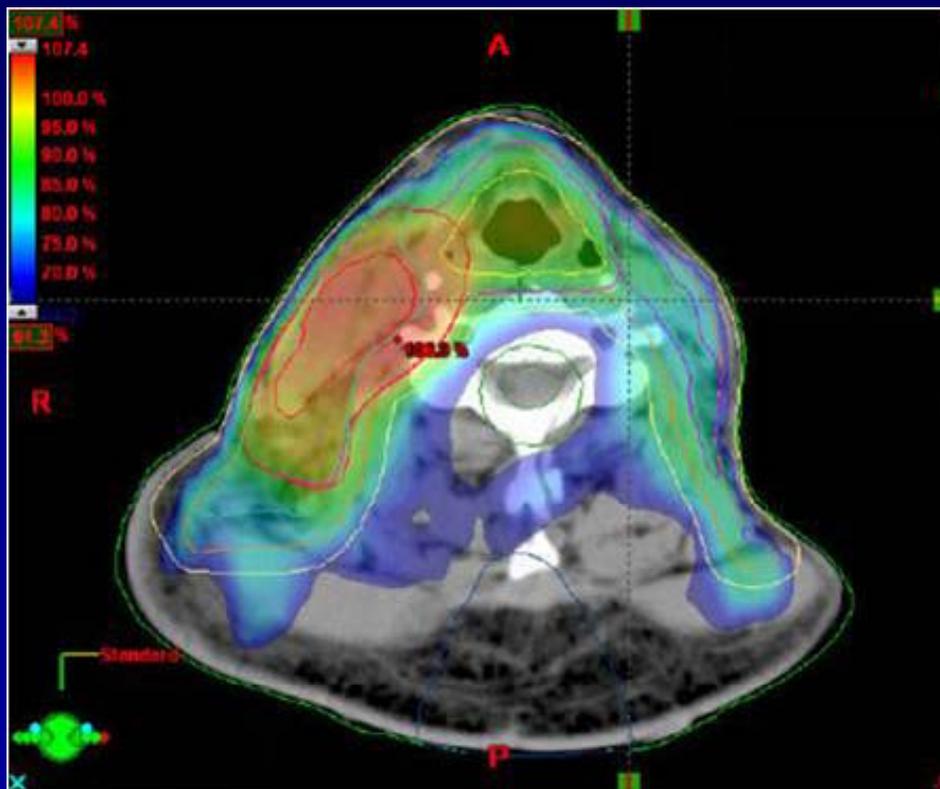




RETOS: PLANIFICACION



ART: Radioterapia Adaptada

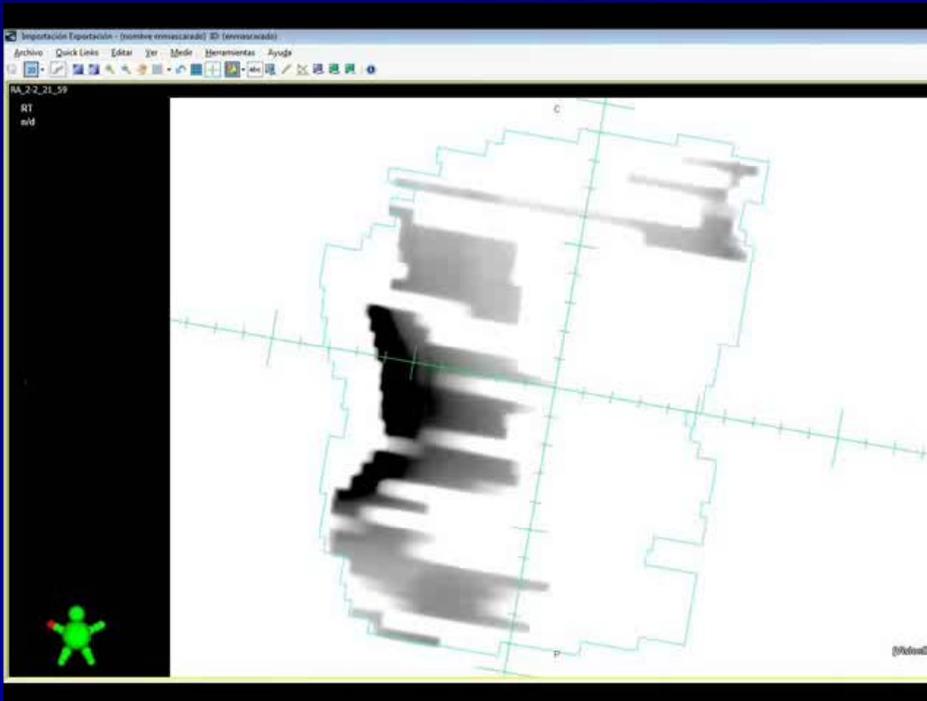
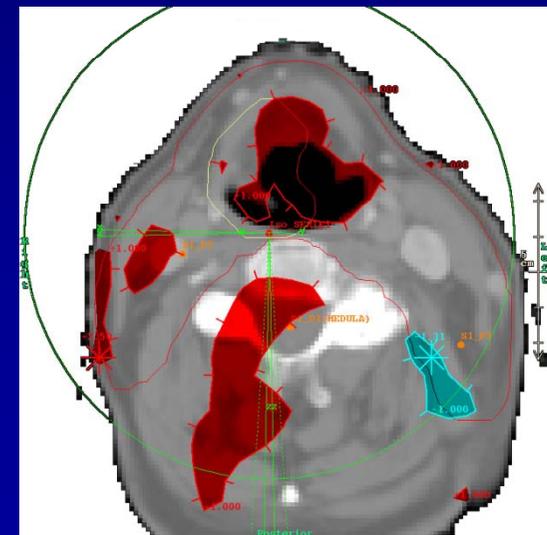
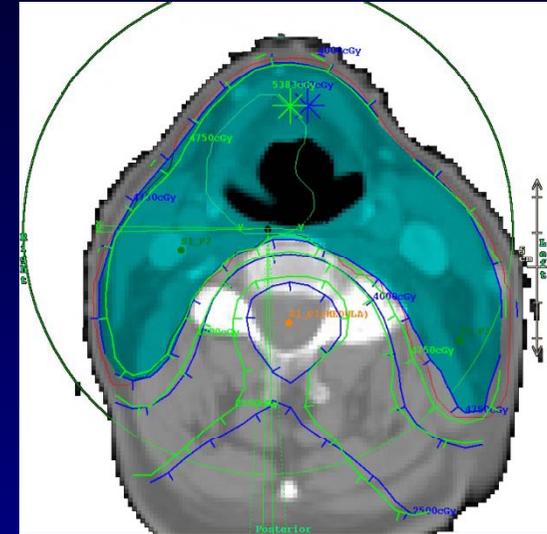
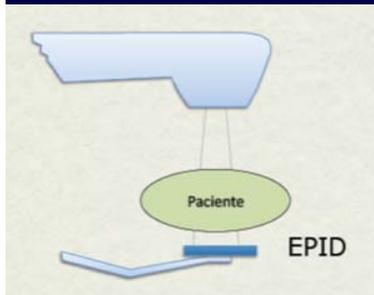




RETOS: VERIFICACION



Dosimetría in vivo volumétrica

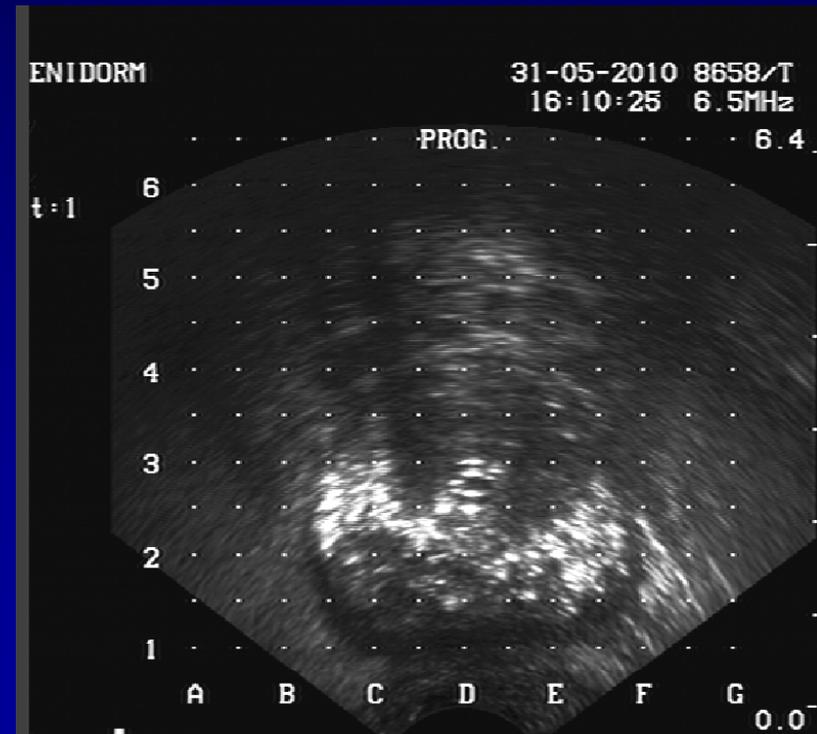
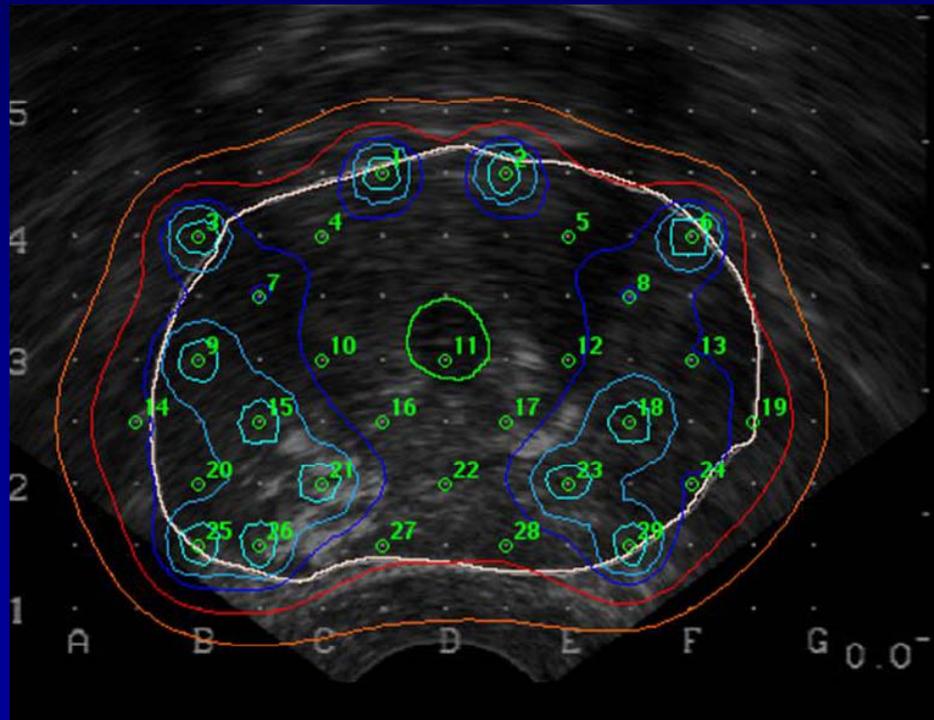




RETOS: CALCULO



Cálculos en baja energía



Contenido

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- Retos
- Evolución tecnológica
- Aportaciones de la CV

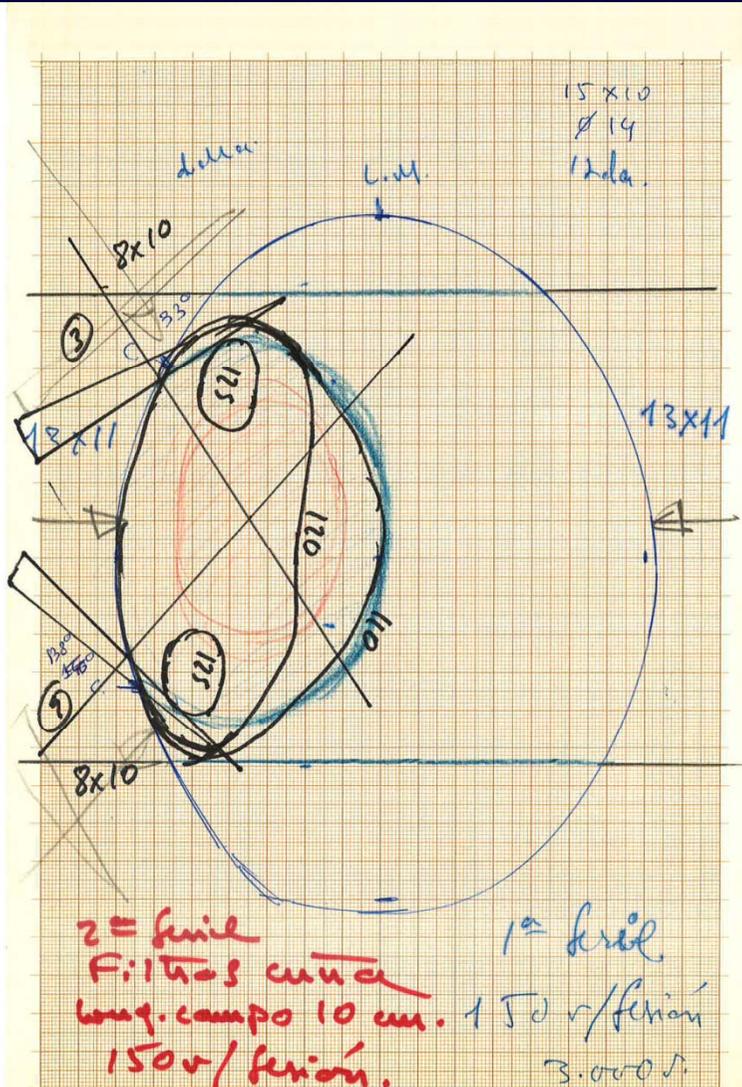
1989



Evolución tecnológica

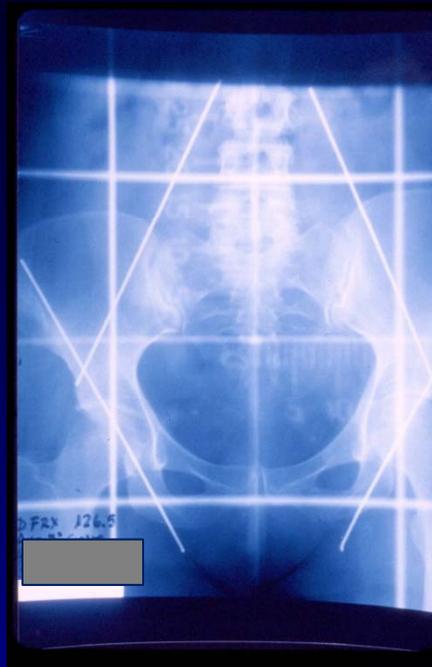


Contorno, cálculo manual



1995

👉 Simulador convencional





Gammateca



Hilos Ir-192

Tubos Cs-137

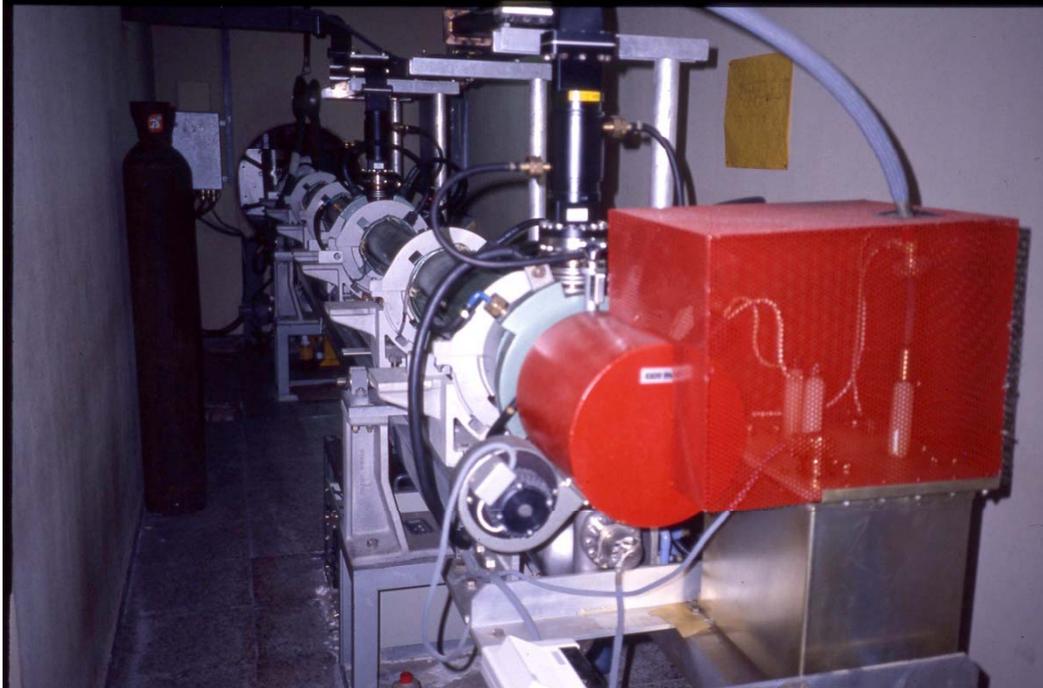


Cobalto



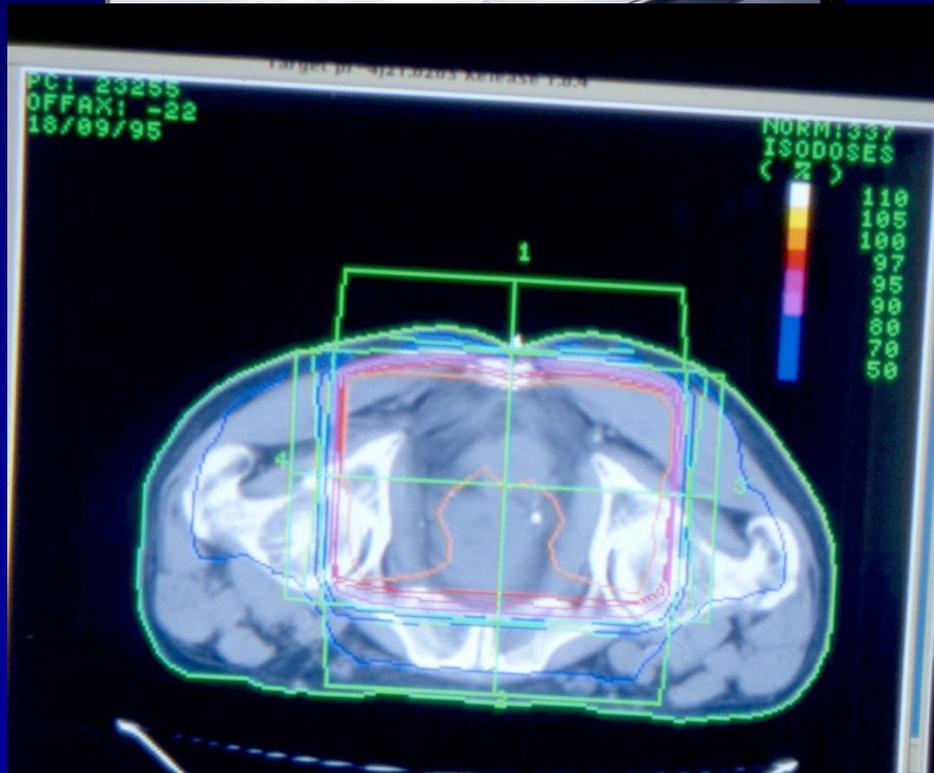
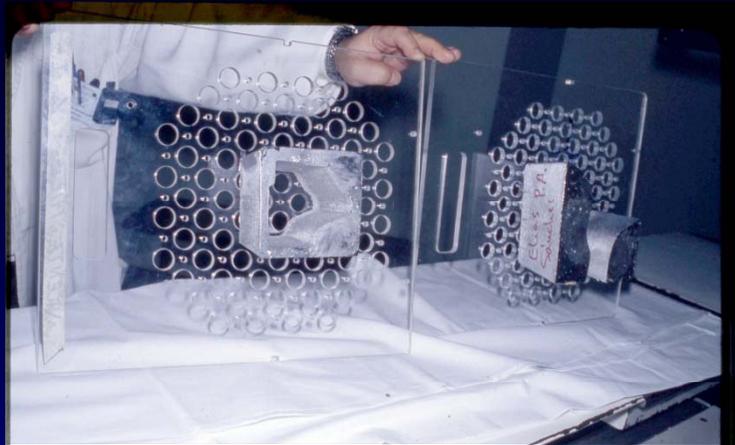


Sagittaire



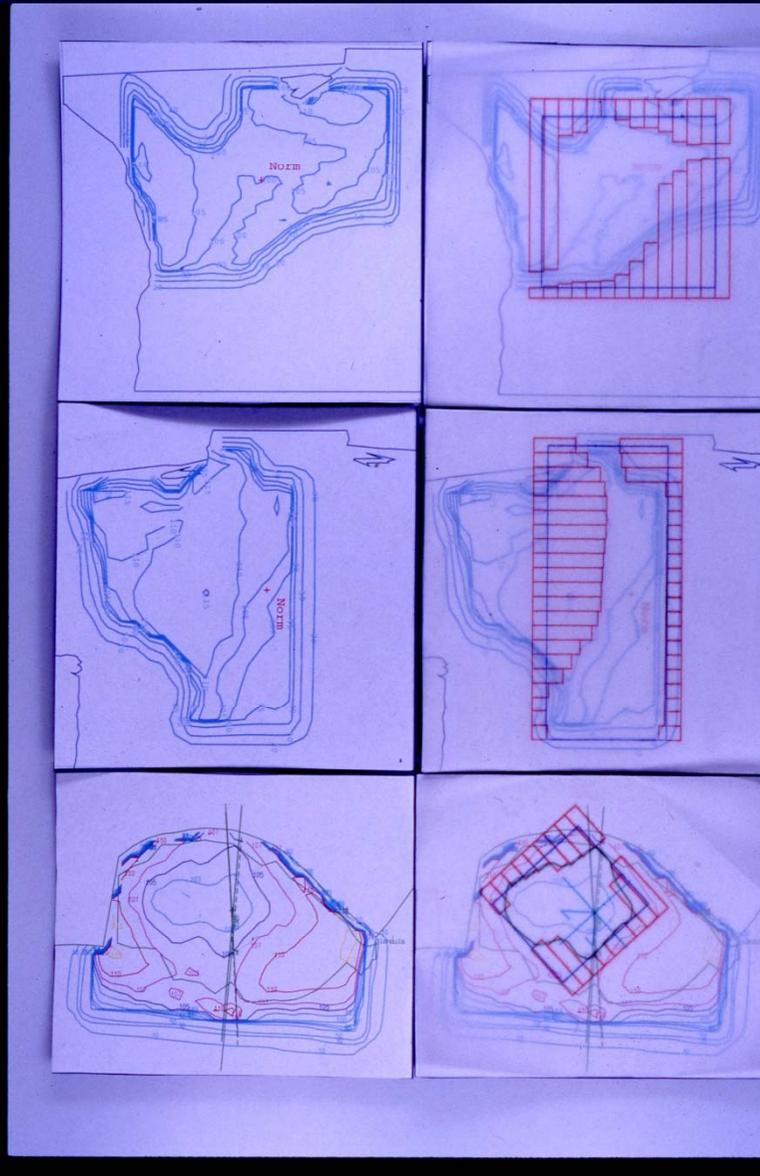


Moldes

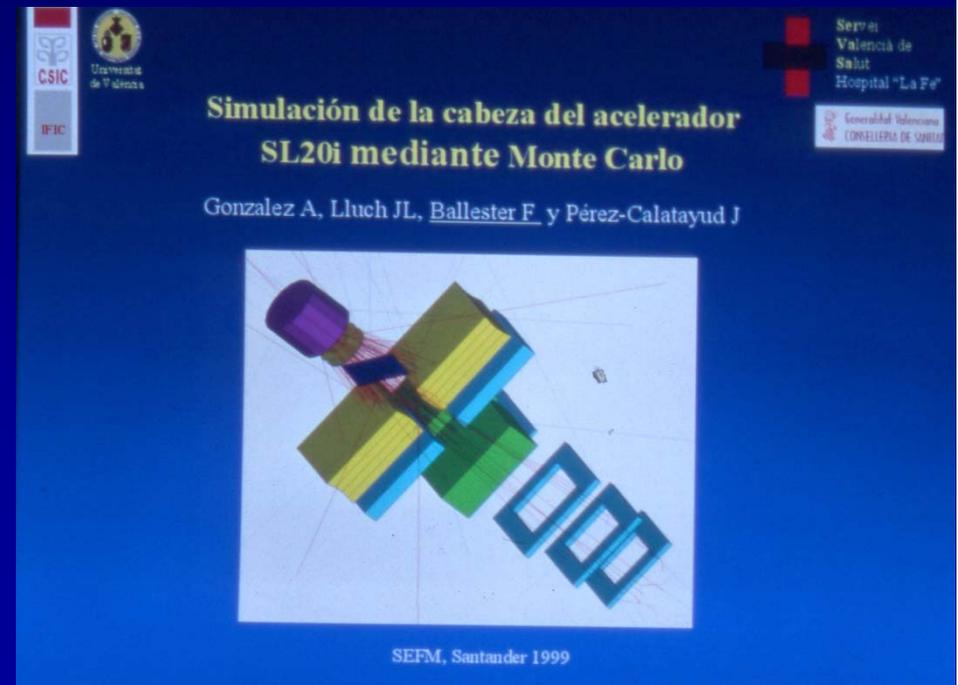


1997

👉 "Aires" o segmentos La Fe

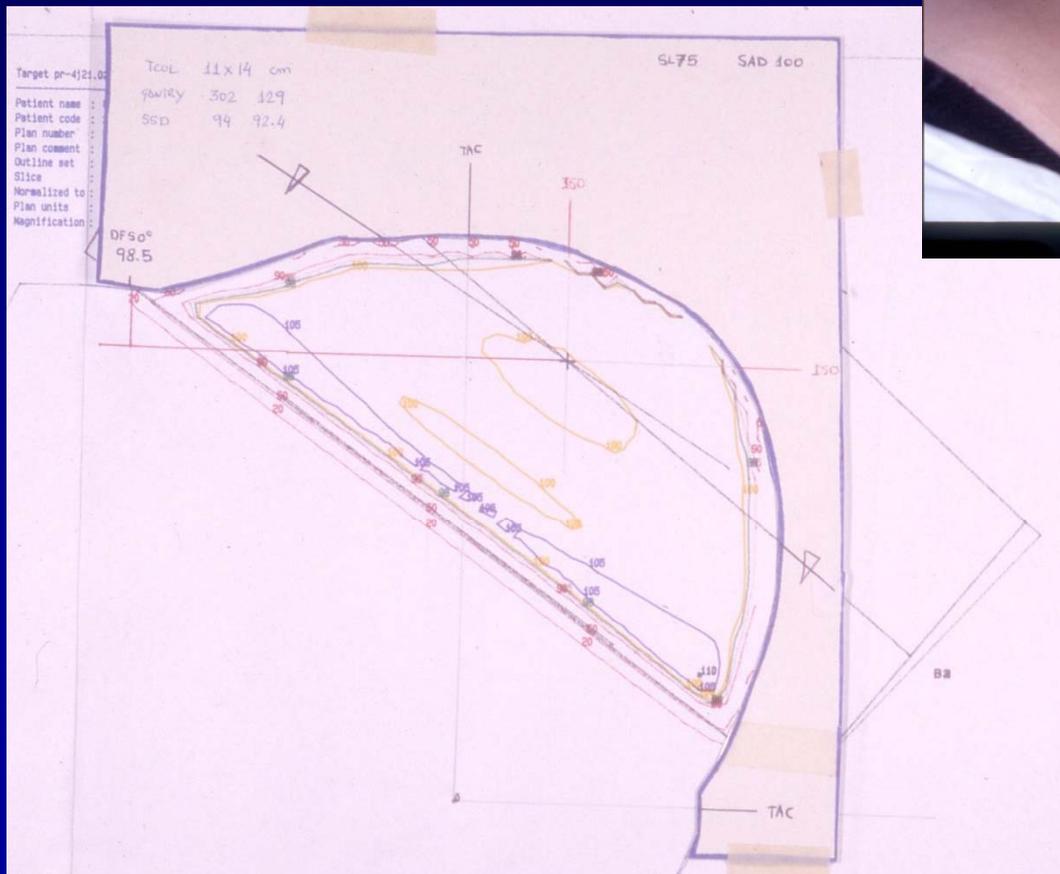
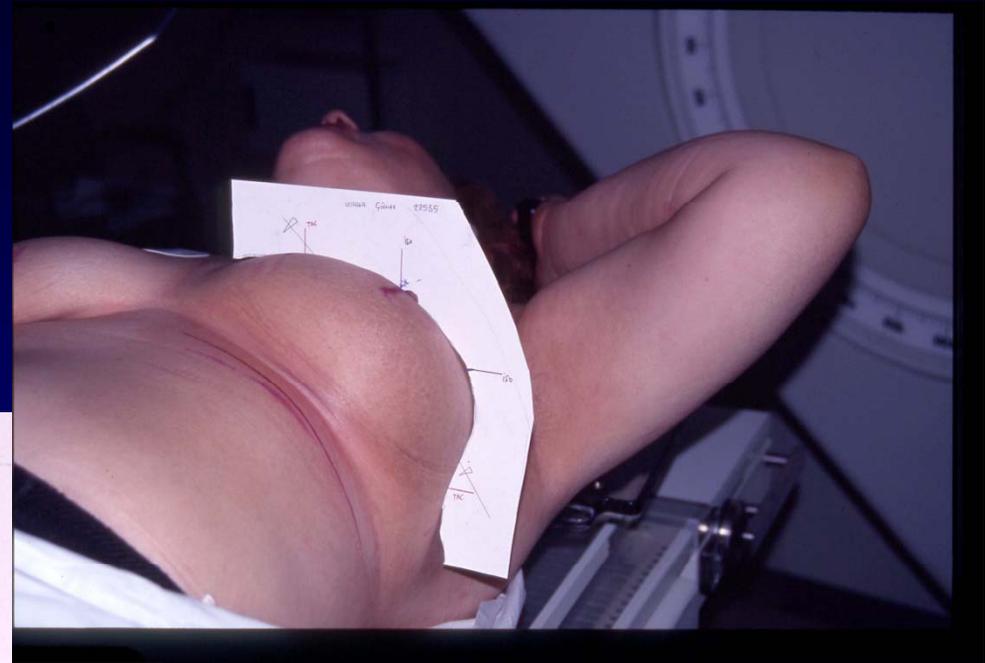


👉 Simulaciones Monte Carlo en F. Fisica UV





Plantillas en La Fe y valores X, Y, Z

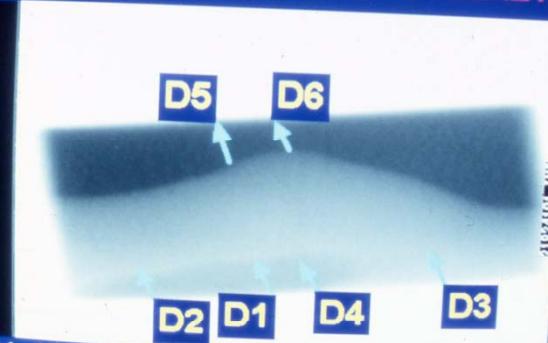




EPID en La Fe



DIFFERENT PARAMETERS ANALYZED



D1, D4: CENTRAL AND MAXIMUM LUNG DISTANCE
 D2, D3: LATERAL LUNG DISTANCES
 D5, D6: CENTRAL AND MINIMUM BEAM EDGE TO SKIN

QUALITY ASSURANCE WITH PORTAL IMAGING IN TANGENTIAL BREAST RADIOTHERAPY

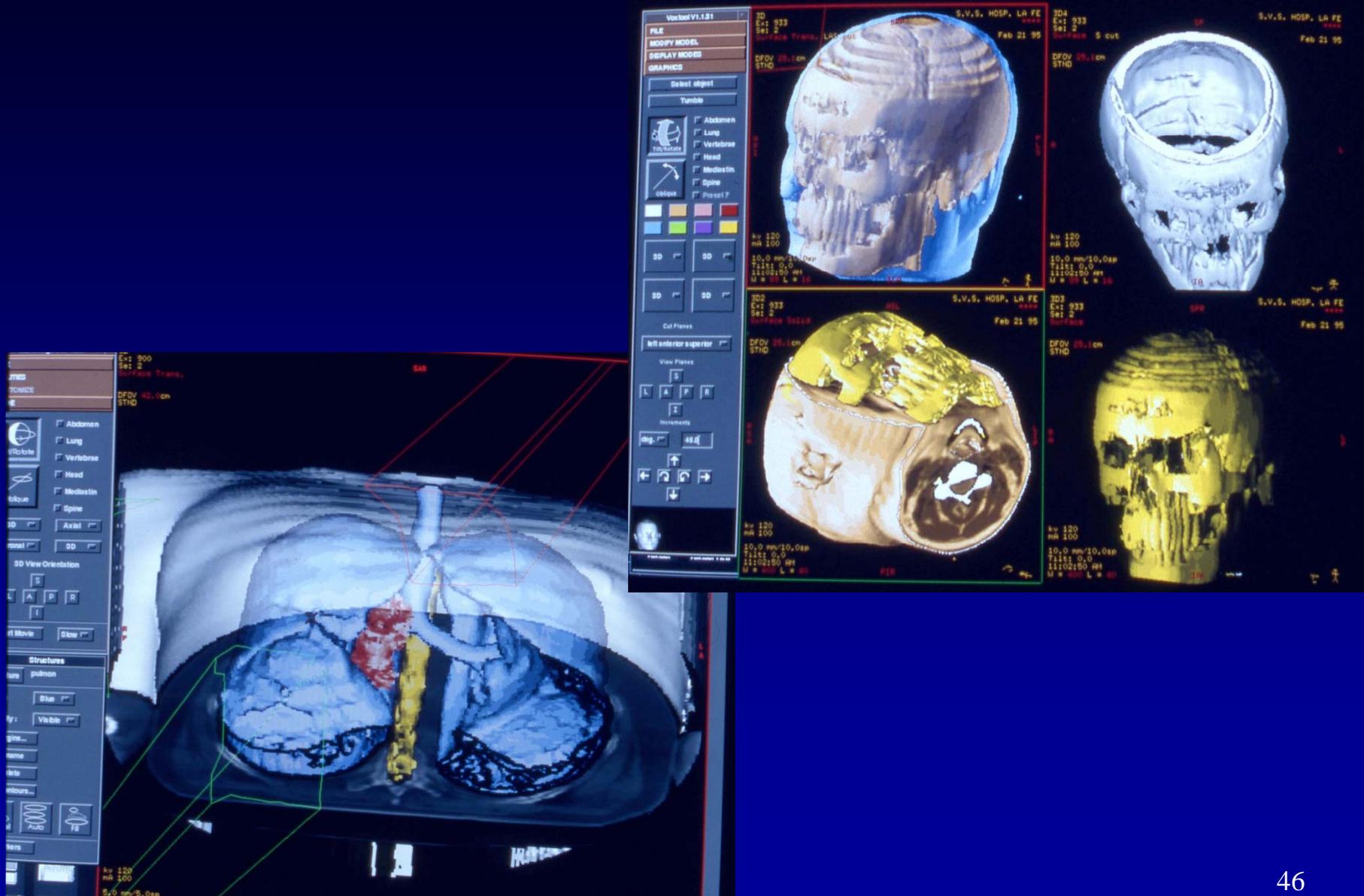
Perez J., Liso F., Carmona V., Tormo A.,
 Pseudo C., Bernisz M., Badal M., Petschen I.

HOSPITAL UNIVERSITARI LA FE
 VALENCIA (SPAIN)

1995



Simulación virtual en La Fe



1996



Primer poster Simulacion Virtual La Fe

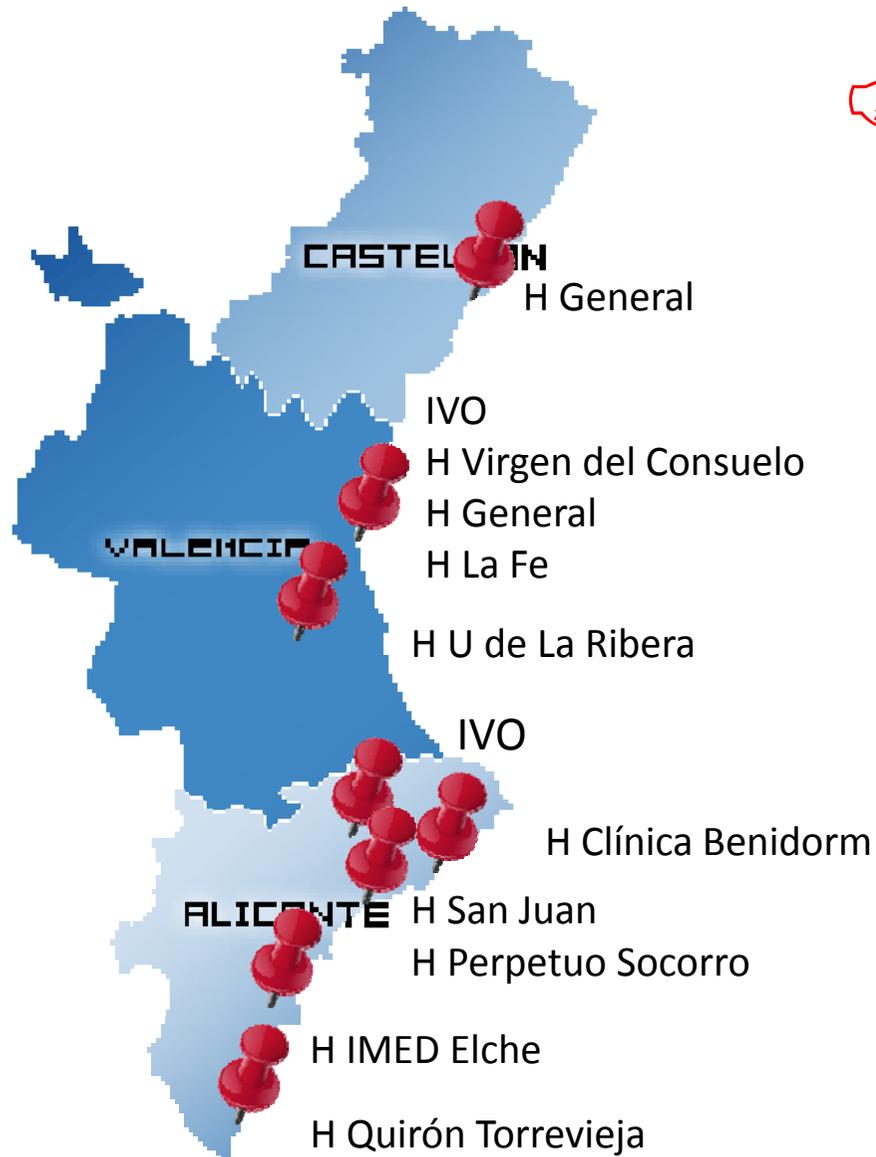


Contenido

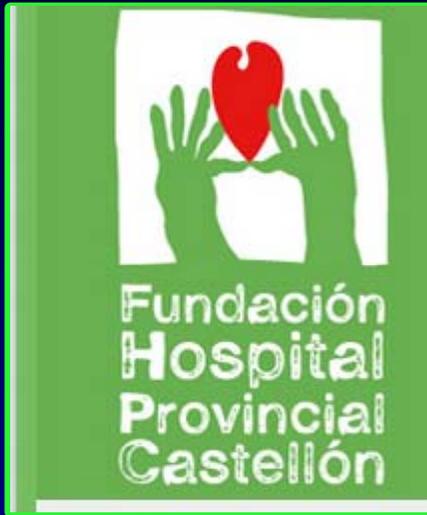
- Radiofísica Hospitalaria
- Radiofísica en Radioterapia
- Oncología Radioterápica: Modalidades y Proceso
- Retos
- Evolución tecnológica
- Aportaciones de la CV



RF en RT
en la CV



☞ RF en RT en la CV



☞ IGRT (CBCT)

☞ Intraoperatoria

☞ BT Próstata

☞ ART

☞ RF en RT en la CV

Hospital Clínic
Universitari
Valencia



☞ Márgen interno IGRT

☞ Simulador TAC

☞ Imagen en RT

☞ Iniciadores Radiocirugía y primer acelerador en la CV (G. Hernández)

☞ RF en RT en la CV

Clínica Virgen Consuelo
Valencia



M. Baños, M^a A. García y J. Bea

☞ Uno de los primeros centros en BT próstata

☞ SBRT

☞ Radiocirugía cerebral

☞ IGRT

☞ RF en RT en la CV



☞ IMRT directa

☞ Dosimetria pellicula

☞ IGRT con tubos RX Exactrac

☞ IGRT externo con sistema luz estructurada



RF en RT en la CV



ivo
FUNDACIÓN
INSTITUTO VALENCIANO DE ONCOLOGÍA



Primer centro español robot HDR



Radiocirugía cerebral



Braquiterapia



IGRT y planificación 4D



RF en RT en la CV



Dosimetría física y clínica



Uno de los centros que primero incorporaron la red con gestión de equipos y documentación electrónica



RF en RT en la CV



IMRT dinámica



Radiocirugía cerebral



Braquiterapia



IGRT

☞ RF en RT en la CV

Hospital Sant Joan
Alicante

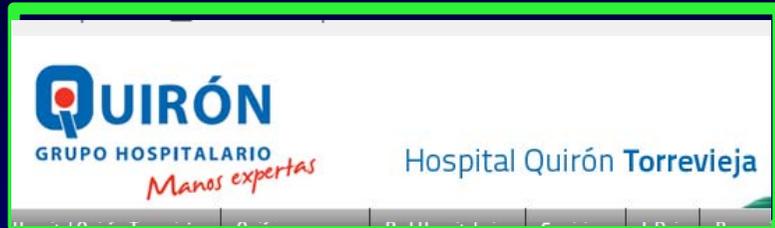


☞ Dosimetría Física

☞ Dosimetría Clínica

☞ Importante iniciativa institucional B. Ballester
(SEFM-SEPR)

☞ RF en RT en la CV



☞ RT Intraoperatoria con acelerador portatil

☞ Medicina Nuclear

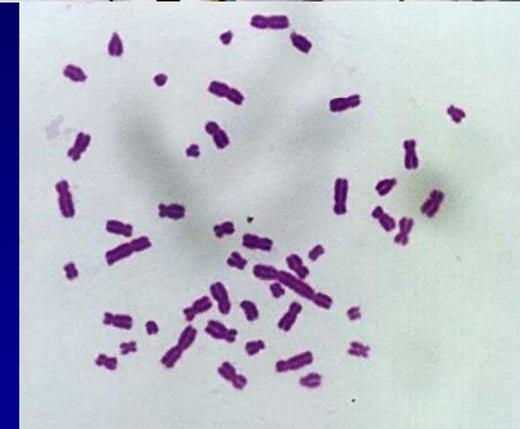
☞ IMRT

☞ IGRT

☞ RF en RT en la CV

La Fe
Hospital
Universitari
i Politècnic

*Servicio de Protección
Radiológica*



- ☞ Dosimetría biológica
- ☞ Radioprotectores y Radiosensibilidad
- ☞ Genotoxicidad
- ☞ Muy importantes colaboraciones

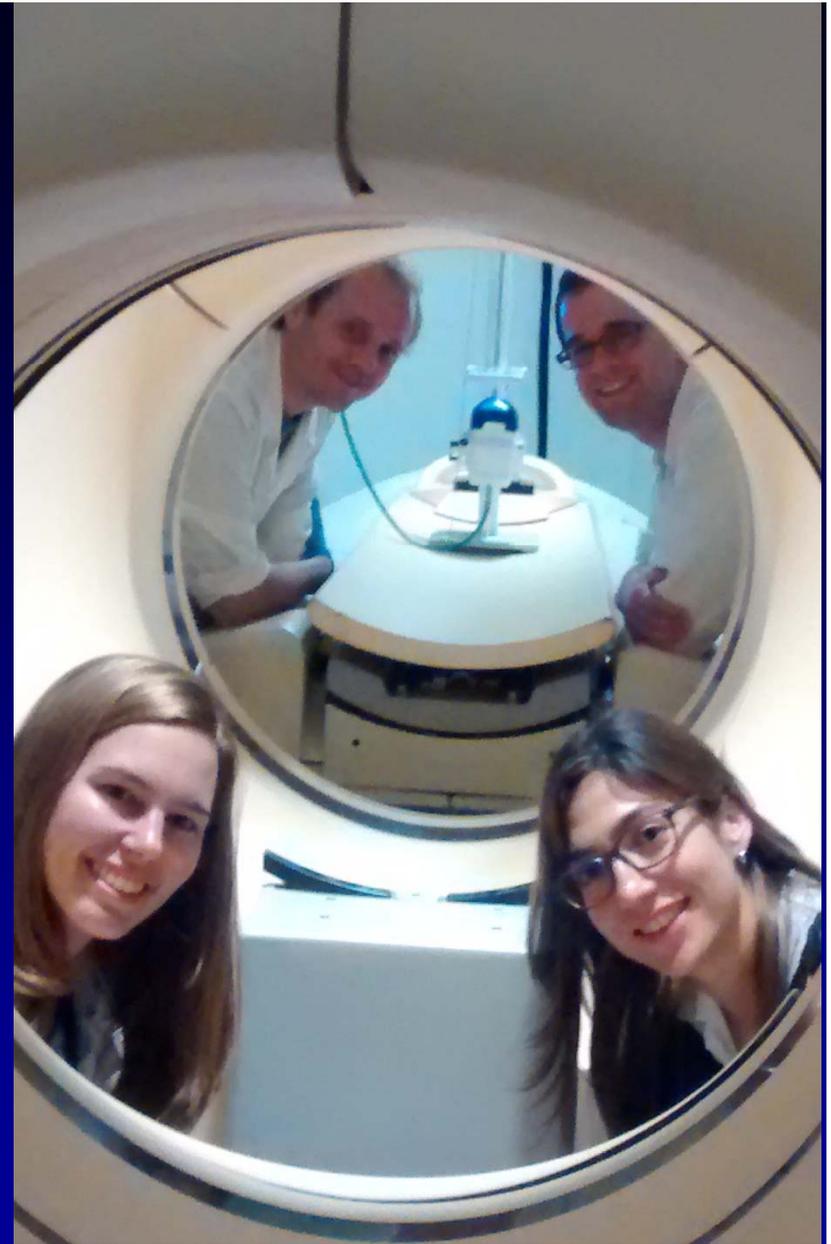
☞ RF en RT en la CV

La Fe
Hospital
Universitari
i Politècnic

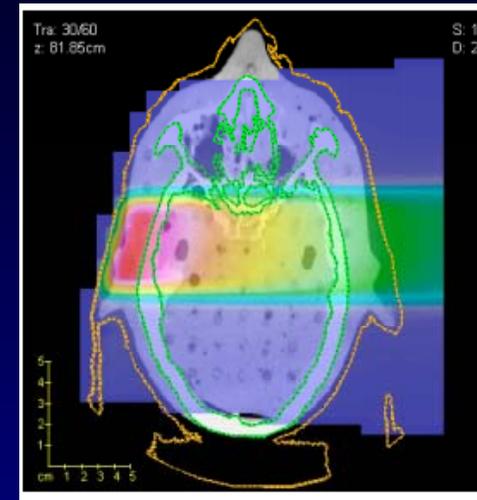
*Servicio de Medicina
Nuclear*

☞ PET-CT en Radioterapia

☞ Semillas de I-125 para
cirugía radioguiada en
Urología



☞ RF en RT en la CV



R. Miró, G. Verdú, B. Juste, P. Botas, V. Abella

Colaboraciones: H. La Fe, H. Clínico y H. General Castellón

☞ Calidad Imagen

☞ Planificación en RT con Monte Carlo

☞ Modelización unidades RT con MC

☞ Protección Radiológica

☞ RF en RT en la CV

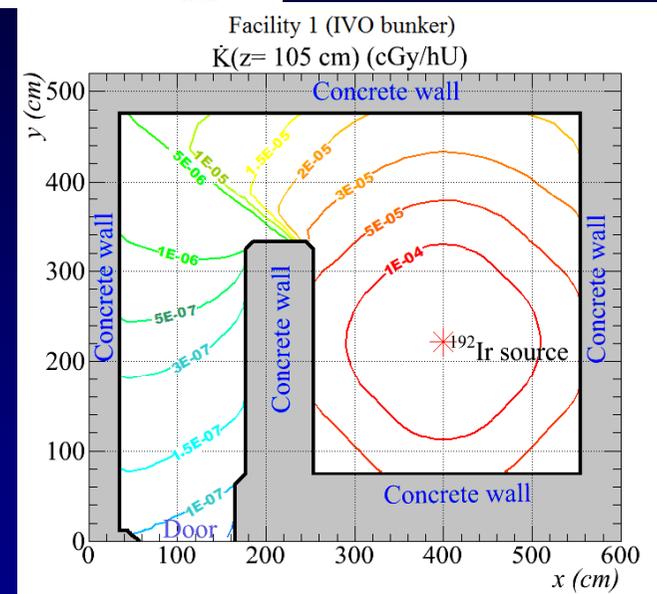
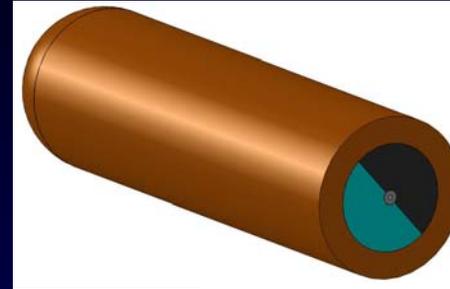
VNIVERSITAT
ID VALÈNCIA (☺)

*Dpto Fisica Atomica
Molecular y Nuclear*

F. Ballester y J. Vijande

Colaboraciones: H. La Fe, C. Benidorm,
H. General, FIVO

- ☞ Simulación Monte Carlo en Braquiterapia
- ☞ Sistemas control calidad en RT
- ☞ Participación grupos AAPM-ESTRO
- ☞ Aplicadores en Braquiterapia



Investigación

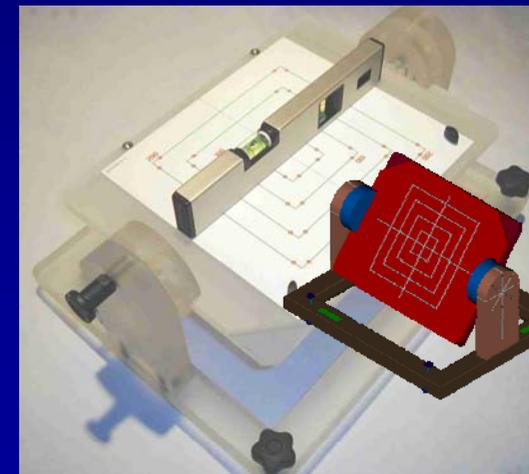
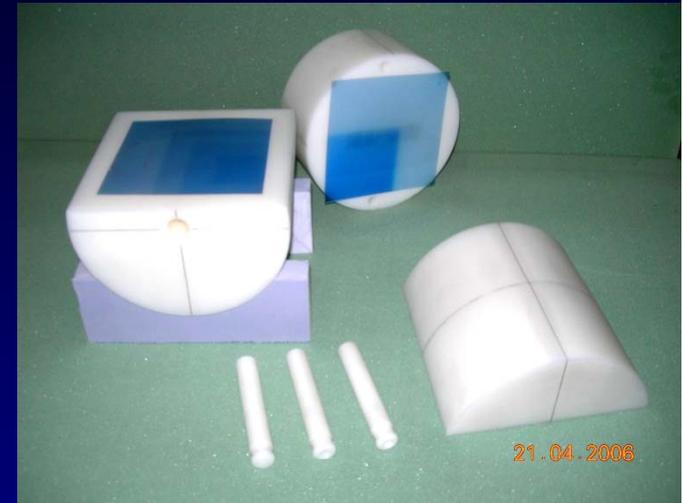
Física Médica en Radioterapia

DFAMN UV + ITIC + H. General + H. La Fe

- Monte Carlo en Braquiterapia
- Diseño de aplicadores
- Datos de consenso planificadores
- Sistemas de control de aceleradores
- IGRT
- Verificación IMRT
- Maniqués IMRT
- Catéter reconstrucción Braquiterapia
- Algoritmo reconstrucción Braquiterapia
- Protocolos piel
- Protocolos GYN con RMN
- ...

Grupo Valencia

Diseño de Maniquies-sistemas medida/control LINAC + BT



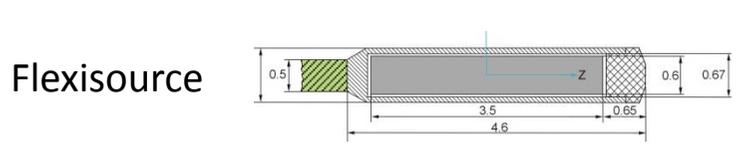
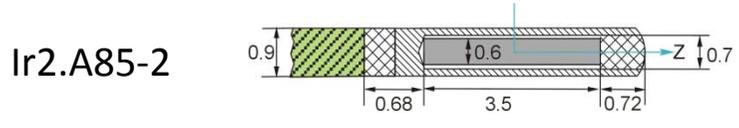
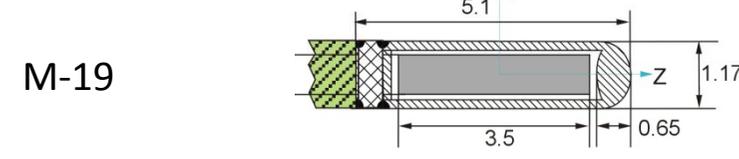
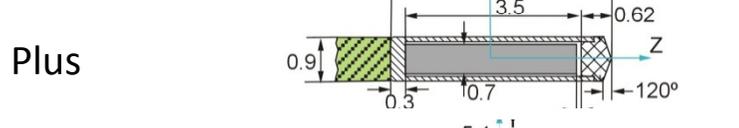
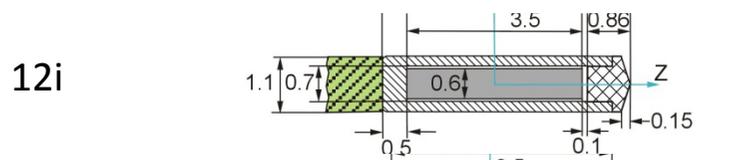
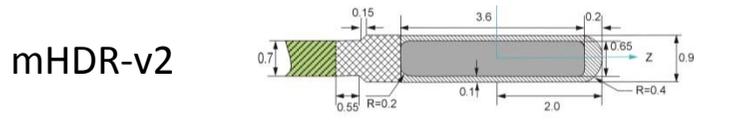
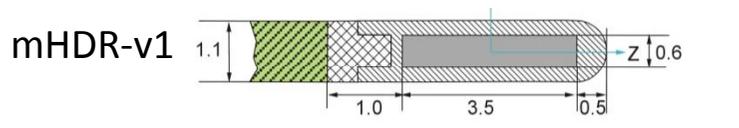
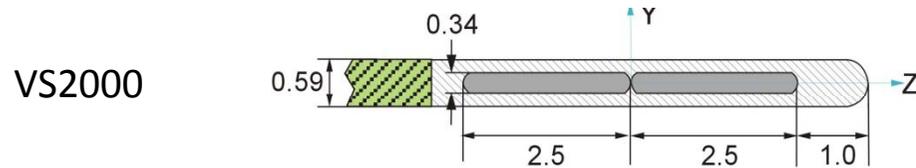


**Dose Calculation for Photon-Emitting
Brachytherapy Sources
with Average Energy Higher than 50 keV:
Full Report of the AAPM and ESTRO**

**Report of the
High Energy Brachytherapy Source Dosimetry (HEBD)
Working Group**

August 2012

AAPM-ESTRO Consensus TG-43 data for Ir-192, Cs-137 and Co-60 LDR-PDR-HDR brachytherapy sources to be used on clinical practice



Source Name (Manufacturer)	$^{CON}\Delta$ [cGy·h ⁻¹ ·U ⁻¹]
mHDR-v1 (Nucletron)	1.116
mHDR-v2 (Nucletron)	1.109
VS2000 (Varian)	1.100
Buchler (E&Z BEBIG)	1.117
GammaMed HDR 12i (Varian)	1.118
GammaMed HDR Plus (Varian)	1.117
GI192M11 (E&Z BEBIG)	1.110
Ir2.A85-2 (E&Z BEBIG)	1.109
M-19 (SPEC)	1.114
Flexisource (Isodose Control)	1.113

r [cm]	$g_s(r)$									
	Nucletron mHDR-v1 L = 0.35 cm	Nucletron mHDR-v2 L = 0.35 cm	Varian VS2000 L = 0.5 cm	E&Z BEBIG Buchler L = 0.13 cm	Varian GammaMed HDR 12i L = 0.35 cm	Varian GammaMed HDR Plus L = 0.35 cm	E&Z BEBIG GI192M11 L = 0.35 cm	E&Z BEBIG Ir2.A85-2 L = 0.35 cm	SPEC M-19 L = 0.35 cm	Isodose Control Flexisource L = 0.35 cm
0.00	0.991	1.276	0.986	1.023	0.992	0.998	0.990	0.990	0.993	0.991
0.06		1.276								
0.08		1.199								
0.10		1.110								
0.15		1.018								
0.20	0.991	1.001	0.986	1.023	0.992	0.998	0.990	0.990	0.993	0.991
0.25	0.992	0.995	0.991	1.018	0.992	0.997	0.990	0.990	0.993	0.991
0.50	0.997	0.997	0.997	1.002	0.994	0.996	0.996	0.996	0.995	0.997
0.75	0.999	0.998	0.999	0.999	0.997	0.998	0.998	0.998	0.998	0.998
1	1	1	1	1	1	1	1	1	1	1
1.5	[1.002]	1.003	1.005	1.003	1.004	1.003	1.003	1.002	1.001	1.002
2	[1.004]	1.005	1.010	1.004	1.006	1.006	1.004	1.004	1.005	1.004
3	[1.006]	1.008	1.012	1.008	1.008	1.006	1.005	1.005	1.008	1.005
4	[1.006]	1.007	1.013	1.007	1.005	1.004	1.004	1.003	1.003	1.003
5	[1.001]	1.003	1.011	1.002	0.999	0.999	0.999	0.999	0.999	0.999
6	[0.993]	0.996	1.003	0.995	0.991	0.993	0.992	0.991	0.994	0.991
8	[0.970]	0.972	0.982	0.971	0.968	0.968	0.968	0.968	0.969	0.968
10	[0.934]	0.939	0.949	0.941	0.936	0.935	0.935	0.935	0.939	0.935

ESTRO Recommendations on QC and clinical brachytherapy planning

Radiotherapy and Oncology 96 (2010) 153–160



ELSEVIER

Contents lists available at ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com



GEC-ESTRO Recommendations

Recommendations from Gynaecological (GYN) GEC-ESTRO Working Group: Considerations and pitfalls in commissioning and applicator reconstruction in 3D image-based treatment planning of cervix cancer brachytherapy

Taran Paulsen Hellebust^{a,*}, Christian Kirisits^b, Daniel Berger^b, José Pérez-Calatayud^c, Marisol De Brabandere^d, Astrid De Leeuw^e, Isabelle Dumas^f, Robert Hudej^g, Gerry Lowe^h, Rachel Wills^h, Kari Tanderupⁱ



Dummies para planificación exclusiva con MR.

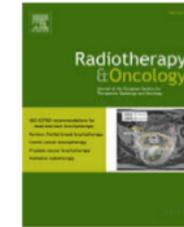
Radiotherapy and Oncology 91 (2009) 181–186



Contents lists available at [ScienceDirect](#)

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com



Cervix cancer brachytherapy

Exclusive MRI-based tandem and colpostats reconstruction in gynaecological brachytherapy treatment planning

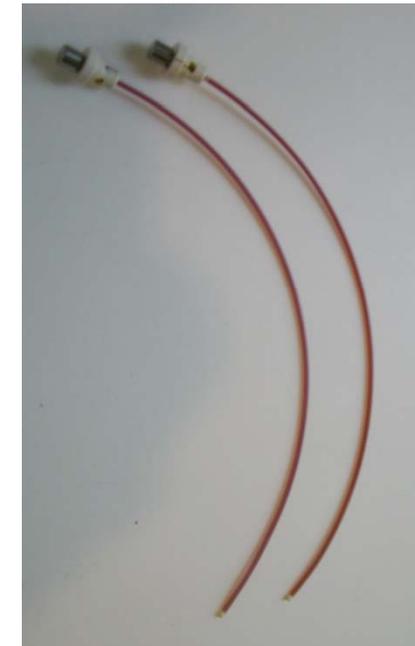
José Perez-Calatayud^{a,d}, Frans Kuipers^b, Facundo Ballester^{c,*}, Domingo Granero^a, José Richart^d,
Silvia Rodriguez^d, Alejandro Tormo^a, Manuel Santos^d

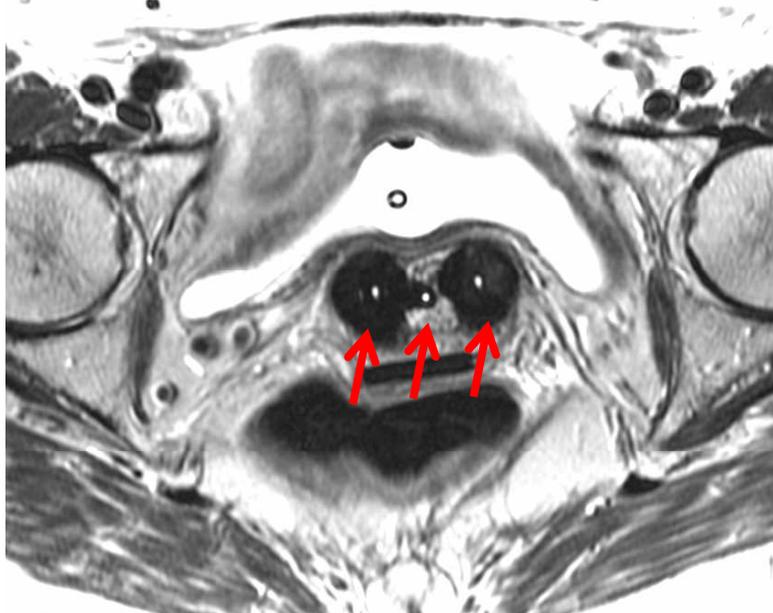
^a Radiotherapy Department, La Fe University Hospital, Valencia, Spain

^b Nucletron B.V., Veenendaal, The Netherlands

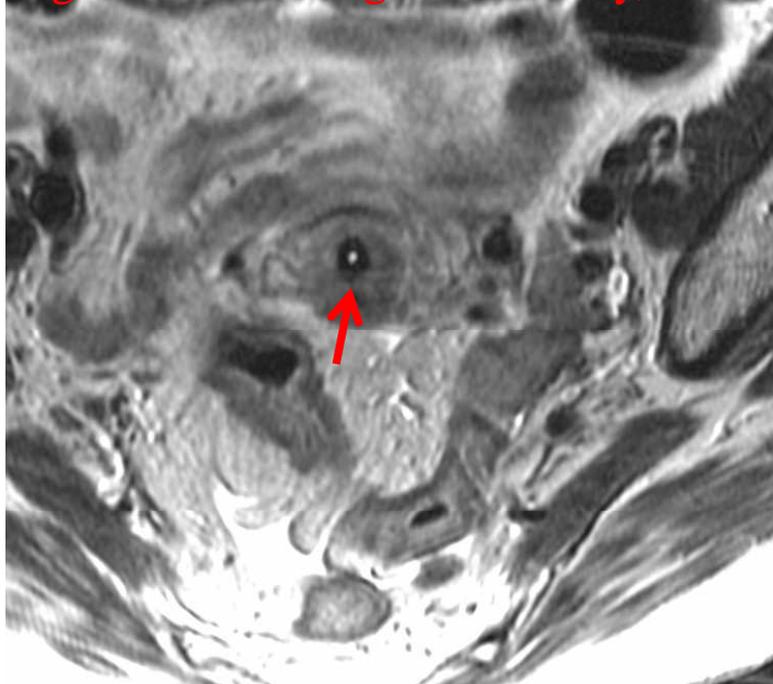
^c Department of Atomic, Molecular and Nuclear Physics, University of Valencia and IFIC-CSIC, Burjassot, Spain

^d Radiotherapy Department, IITC, Benidorm Hospital, Benidorm, Spain





Signal on MR images of dummy, used to perform catheter reconstruction



Grupo Valencia

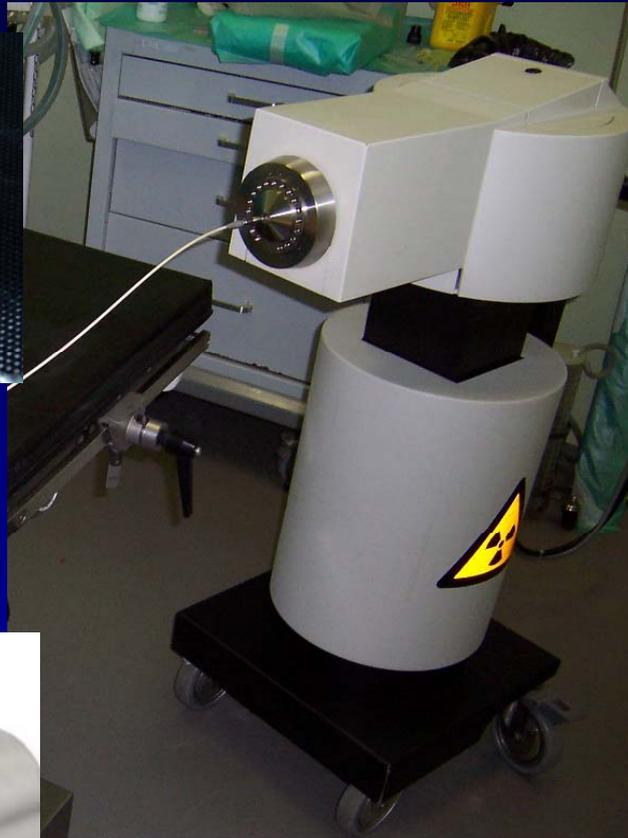
Diseño de los Aplicadores VALENCIA



Basocelulares
2-4 mm



New Valencia App



Control & resultados cosmeticos excelentes

Tormo et al JCB 2014



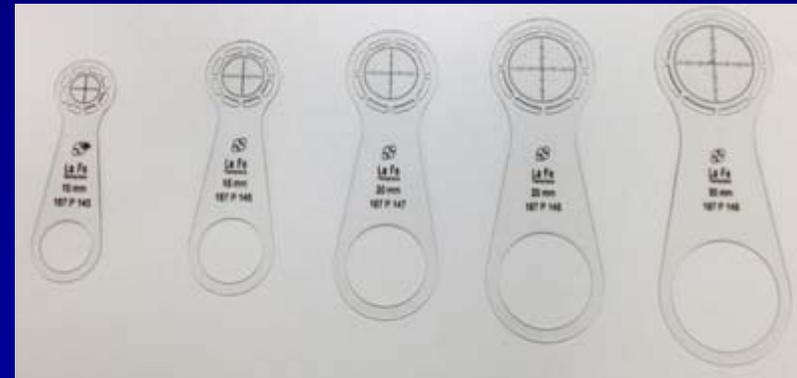
Colaboración empresas: Esteya

👍 Braquiterapia electrónica





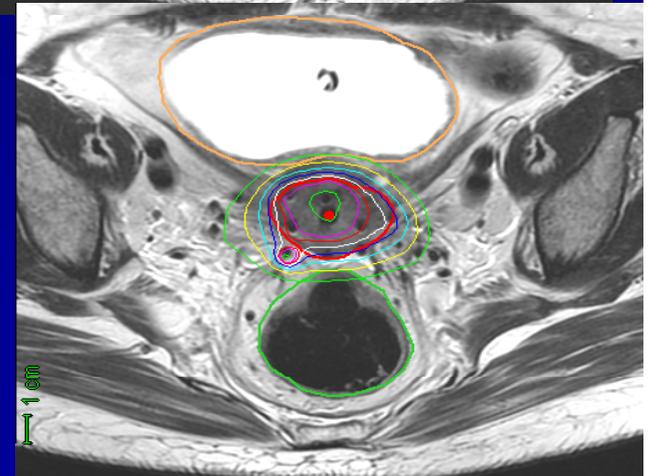
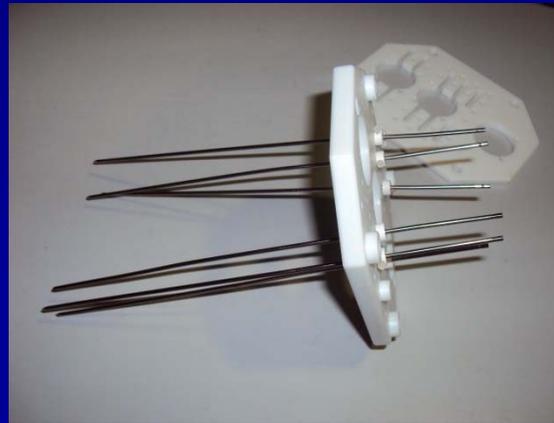
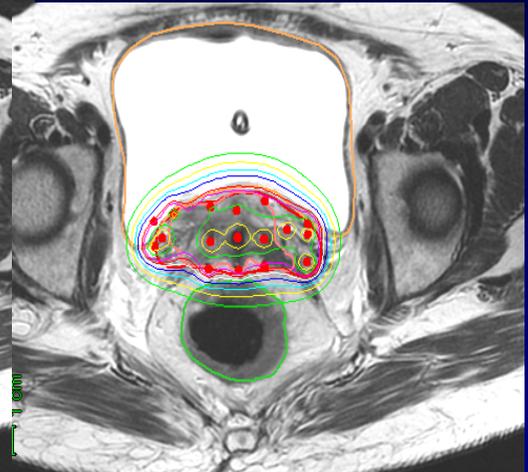
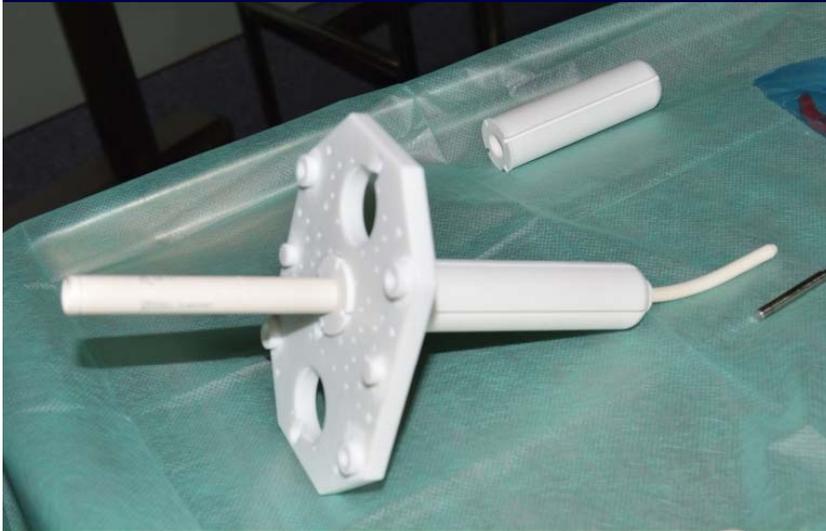
Templates LA FE



Marcado paciente aplicadores piel

Colaboración empresas

👍 Aplicador Benidorm



Rodriguez et al 2014

Grupo Braquiterapia (Coordinador)	SEFM
Comite Cientifico	SEFM
BRAPHYQS (Grupo calidad braquiterapia)	ESTRO
ESTRO-GEC Committee	ESTRO
Grupo HEBD Braquiterapia (Coordinador)	AAPM
Brachytherapy Subcommittee	AAPM
TG-143 Elongated Sources	AAPM
TG-253 Skin Applicators	AAPM
WG Clinical Applications Brachytherapy	AAPM
Model Based Dose Calculations Algorithms	AAPM
Brachytherapy Source Registry	AAPM
Physics Committee	ABS
Guidelines Skin brachytherapy	ABS

Gracias



Gracias





Hospital La Fe

- F. Lliso
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- C. Candela
- A. Tormo

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- F.A. Siebert
- R. van der Laarse

ITIC. Benidorm

- J. Richart
- S. Rodríguez
- M. Santos
- A. Otal

M. Genes FRESA

- D. Granero

CND

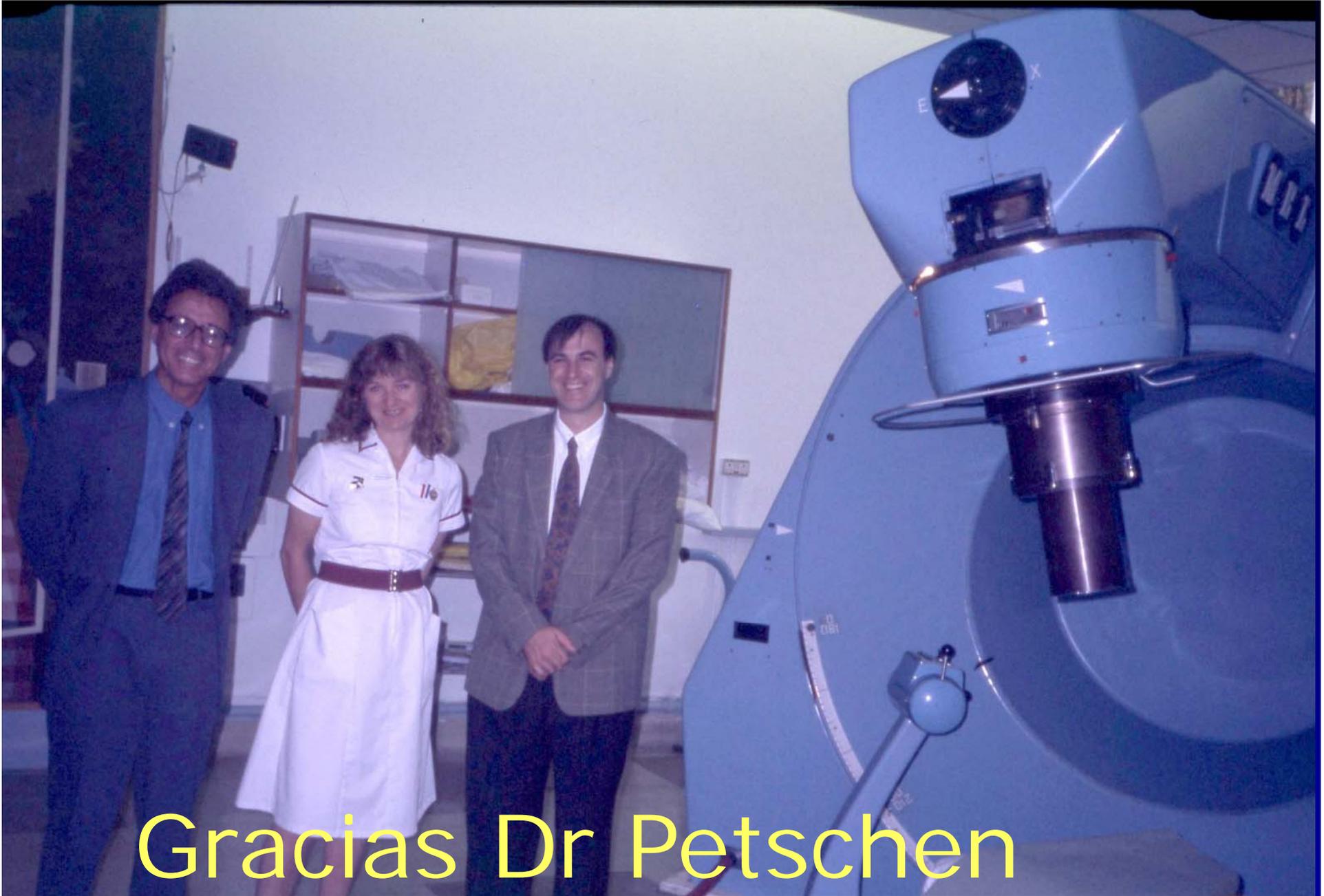
- M.C. Pujades

Universidad Valencia

- F. Ballester
- J. Vijande

USA

- M. Rivard
- Z. Ouhib
- A. Meigooni
- R. Nath
- J.F. Williamson
- C. Melhus



Gracias Dr Petschen