

Planificación de oligometástasis vertebrales basada en sistema **ELEMENTS**

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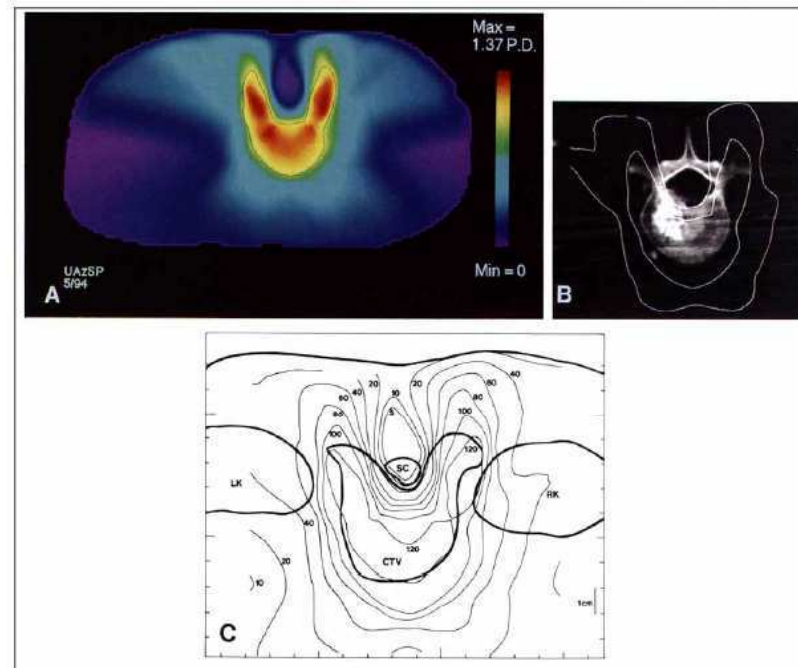
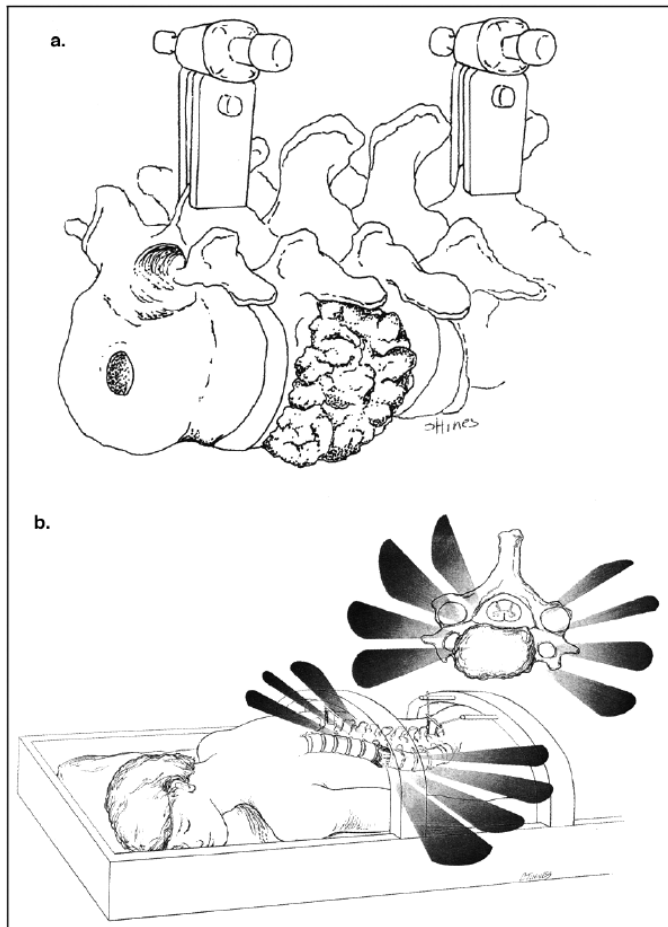


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2° Simposio Internacional
de **RADIOCIRUGÍA
ESTEREOTÁCTICA**
con plataforma Novalis



SBRT columna (Hamilton et al. 1995)



- IGRT ?
- Sistema colimación ?
- Tiempos de irradiación ? , etc.

Neurosurgery 1992-98
February 1995, Volume 36, Number 2
311 Preliminary Clinical Experience with Linear Accelerator-based Spinal Stereotactic Radiosurgery Technique and Application

AUTHOR(S): Hamilton, Allan J., M.D.;
Luh, Bruce A., Ph.D.; Fosmire, Helen, M.D.;
Stea, Baldassarre, M.D., Ph.D.;
Cassady, J. Robert, M.D.



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SBRT columna: técnica tratamiento

- Es necesario haces modulados por concavidad del volumen de tratamiento (IMRT – VMAT)
- **IMRT** múltiples campos (> 9campos)
- **VMAT** con múltiples arcos completos o parciales
- Alta tasa de dosis – Tiempo de tratamiento
- **NO** necesario incidencia no-coplanares
- **IGRT on-line**



Simulación virtual esferas reflectoras TAC



Definición de volúmenes

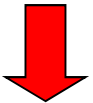
- Cuerpo vertebral y pedículos
localización mas típica
- Cuerpo vertebral completo
- Elemento dorsal
- **OARs**
 - Medula espinal PARCIAL (5-6mm PTV)
 - Tronco / Cauda equina
 - Esófago
 - Pulmones
 - Riñones
 - Hígado, etc.



Simulación virtual
esferas reflectoras
TAC



Definición de
volúmenes



**Prescripción
Dosis**



- **PTV: 3fx – 12Gy**
- PTV cercano o superpuesto con OARs
- Modalidad de tratamiento con alto gradiente de dosis (IMRT, HybridARC, VMAT)
- Tolerancia de OAR por sobre dosis a PTV



Simulación virtual
esferas reflectoras
TAC



Definición de
volúmenes



**Prescripción
Dosis**

- **PTV: 3fx – 12Gy**

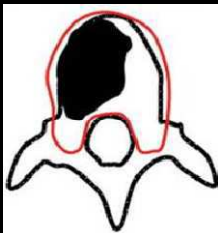
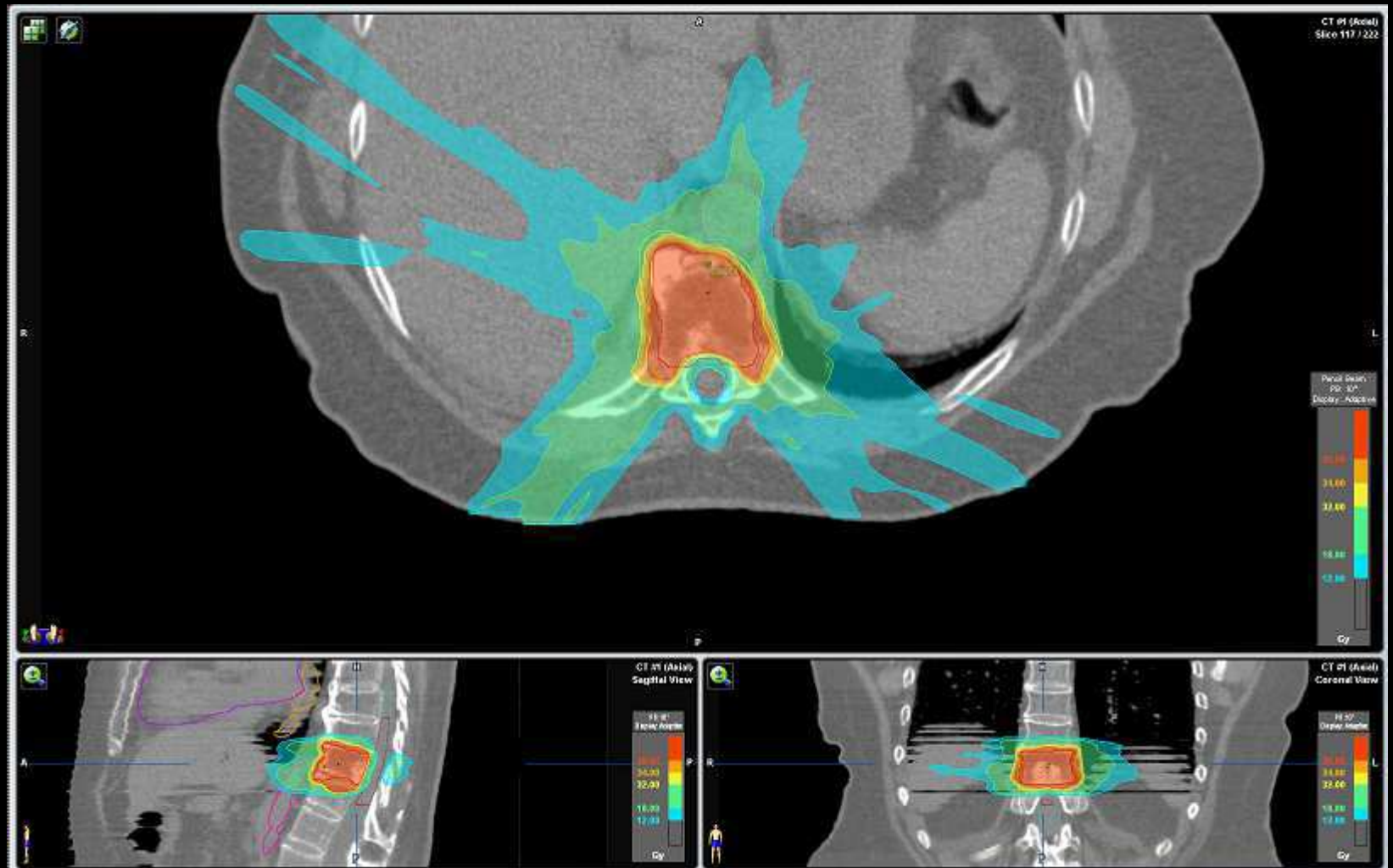
Serial Tissue	Volume (mL)	Volume Max (Gy)	Max Point Dose (Gy)	Endpoint (≥Grade 3)
THREE-FRACTION TR				
Optic pathway	<0.2	15 (5 Gy/fx)	Tronco	
Cochlea				
Brainstem	<1	18 (6 Gy/fx)		
Spinal cord	<0.25	18 (6 Gy/fx)		<0.5 cc
	<1.2	11.1 (3.7 Gy/fx)		< 18 Gy
Cauda equina	<5	21.9 (7.3 Gy/fx)	Medula	
Sacral plexus	<3	22.5 (7.5 Gy/fx)		Dmax
Esophagus*	<5	21 (7 Gy/fx)		< 23.1 Gy
Ipsilateral brachial plexus	<3	22.5 (7.5 Gy/fx)		
Heart/pericardium	<15	24 (8 Gy/fx)	Medula	
Great vessels	<10	39 (13 Gy/fx)		
Trachea and ipsilateral bronchus*	<4	15 (5 Gy/fx)		
Skin	<10	22.5 (7.5 Gy/fx)		<0.35 cc
Stomach	<10	21 (7 Gy/fx)	Medula	< 18 Gy
Duodenum*	<5	15 (5 Gy/fx)		Dmax
Jejunum/ileum*	<5	16.2 (5.4 Gy/fx)		< 21.9 Gy
Colon*	<20	20.4 (6.8 Gy/fx)		
Rectum*	<20	20.4 (6.8 Gy/fx)	Medula	<1.2 cc
Bladder wall	<15	15 (5 Gy/fx)		< 12.3 Gy
Penile bulb	<3	21.9 (7.3 Gy/fx)		
Femoral heads (right and left)	<10	21.9 (7.3 Gy/fx)		
Renal hilum/vascular trunk	<2/3 volume	18.6 (6.2 Gy/fx)	Cauda Equina	
Parallel Tissue	Critical Volume (mL)	Critical		
Lung (right and left)	1,500			<5 cc
Liver	700			< 21.9 Gy
Renal cortex (right and left)	200			Dmax
				< 24.0 Gy



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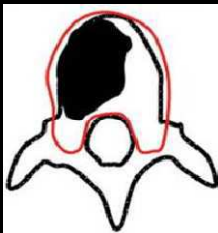
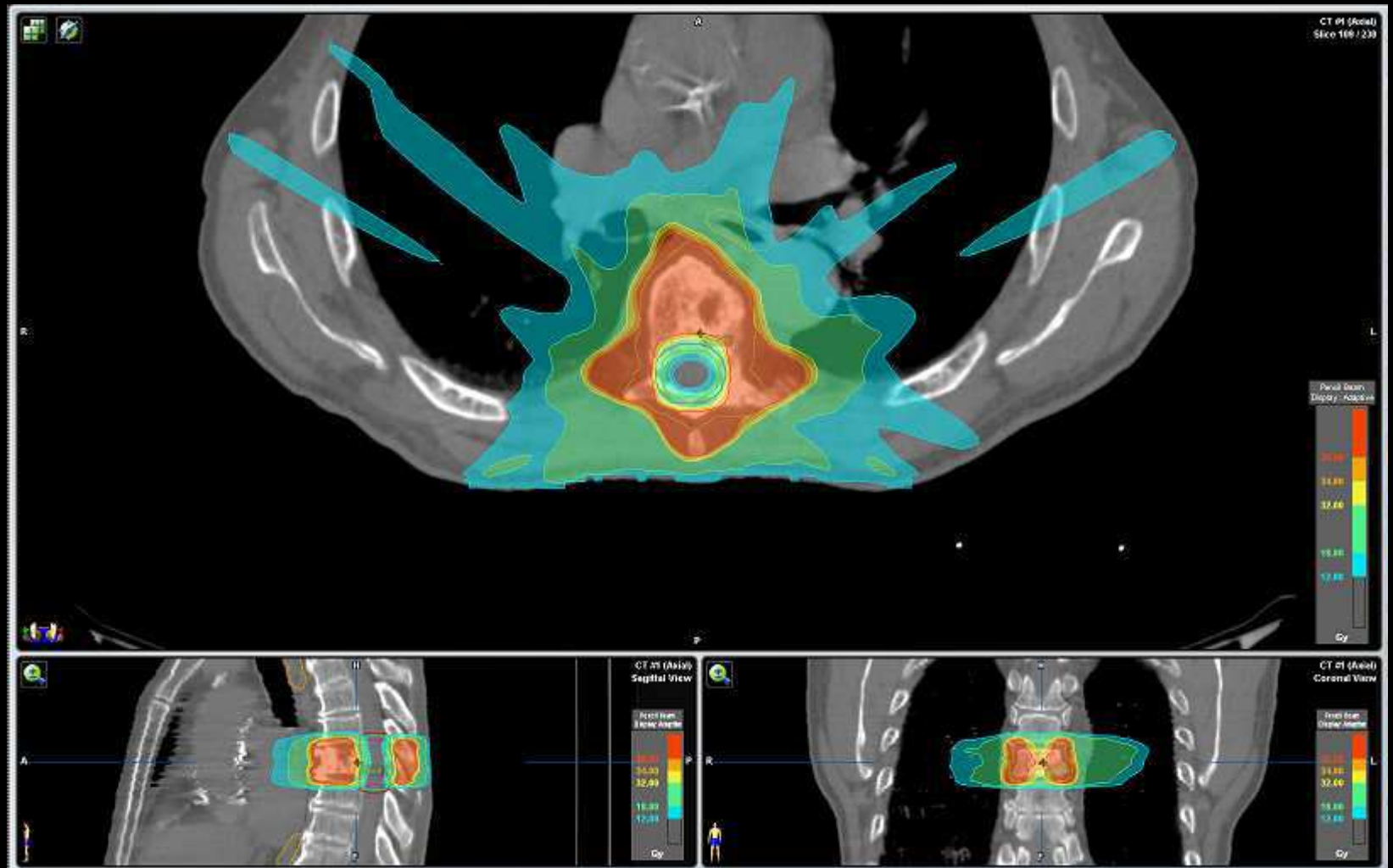
Diferencia de dosis entre PTV y OARs => **Planificación sofisticada**

SBRT 36y – 3fx



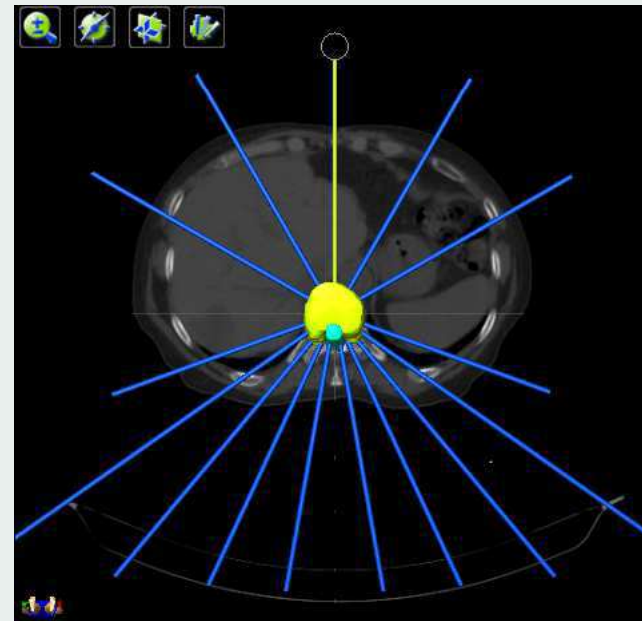
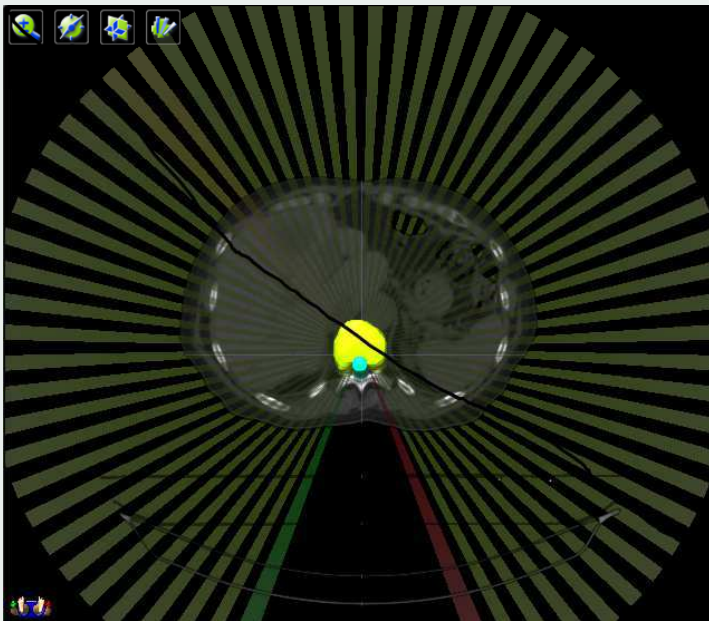
BED = 79Gy

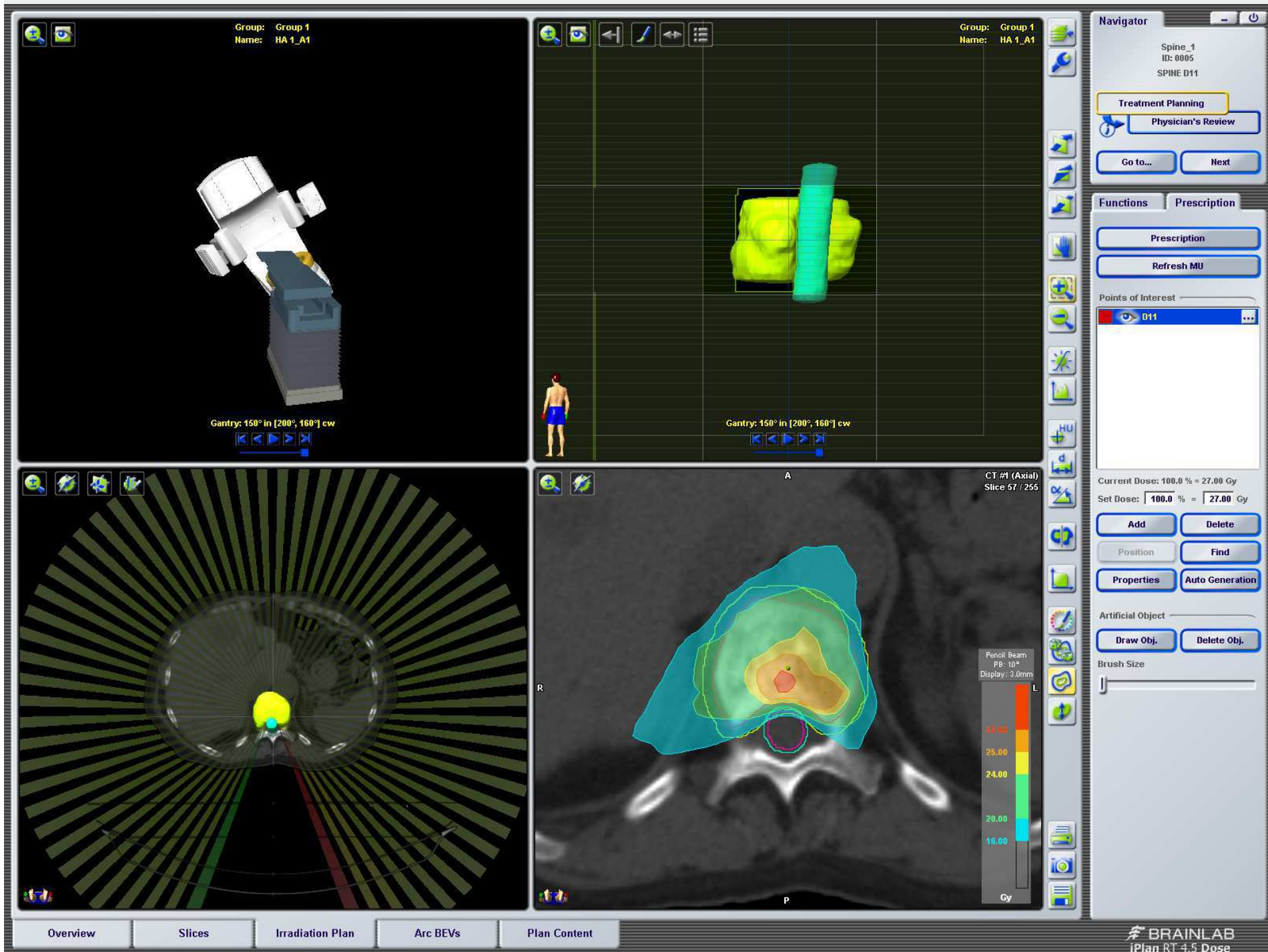
SBRT 36y – 3fx



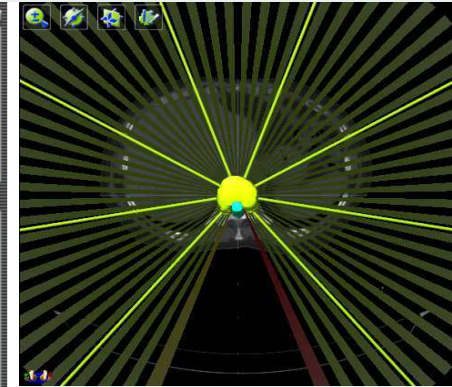
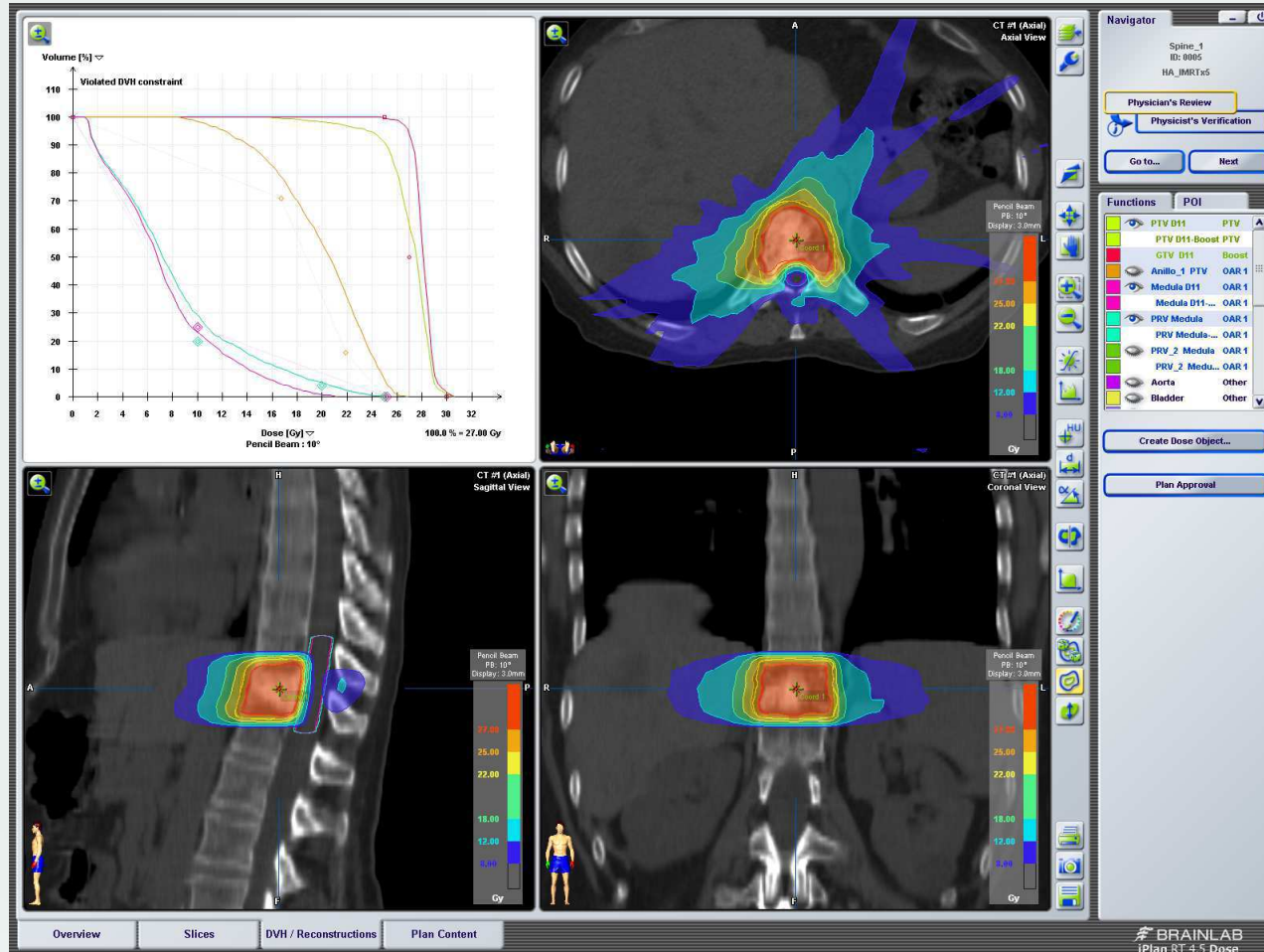
BED = 79Gy

- HybridArc™ combina dos métodos de tratamiento probados para radiocirugía, **Arcos dinámicos** modulados y haces de **IMRT fijos**, con una mezcla automatizada y optimizada





Spine Mts. HybridArc

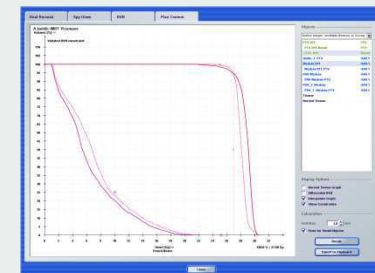
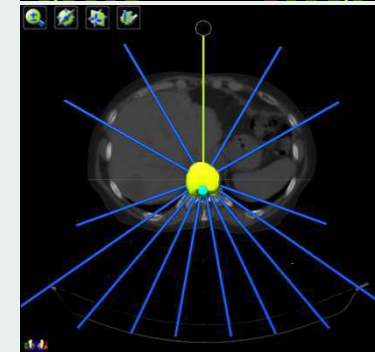
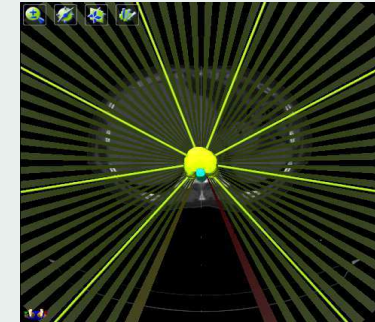
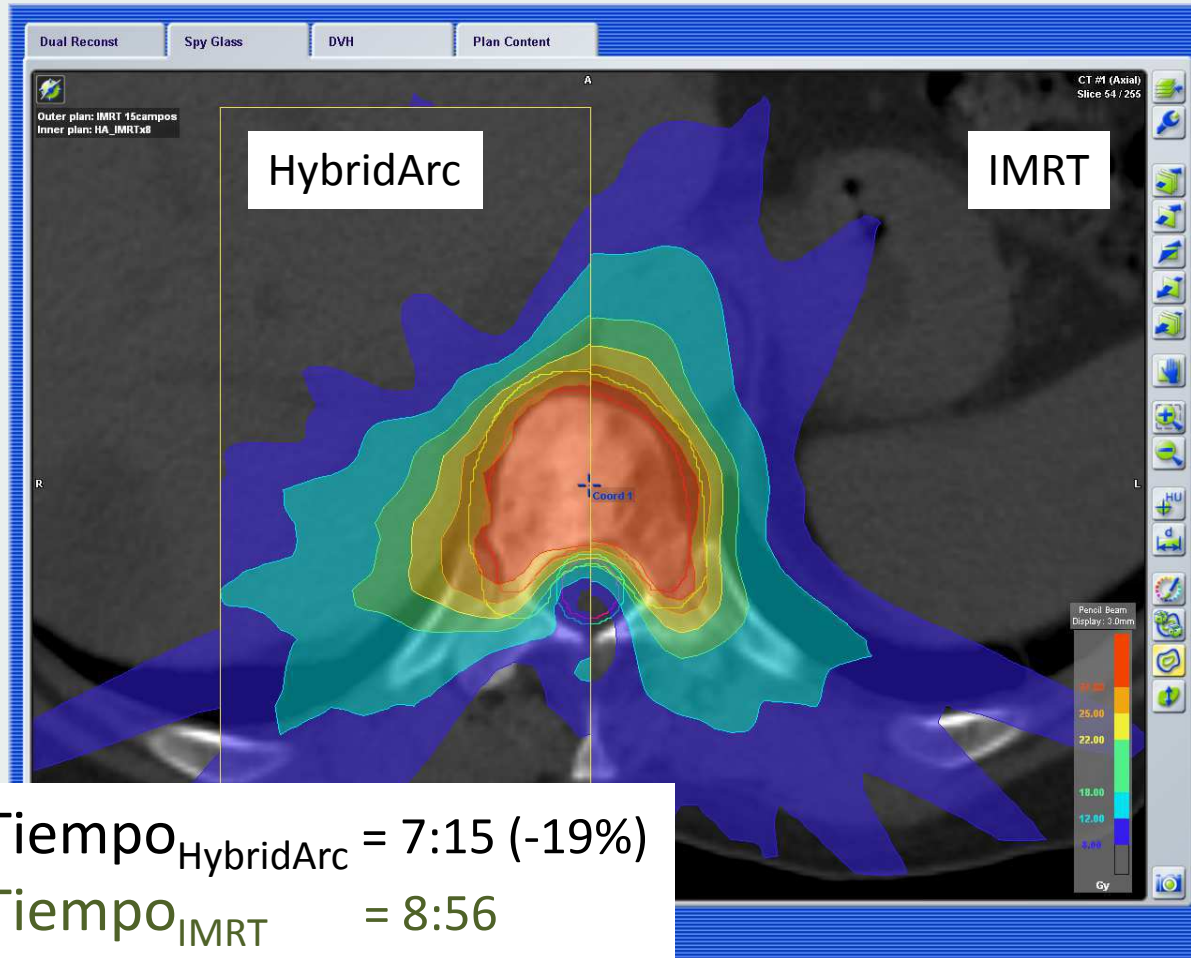


Novalis TX - SRS6MV
 $UM_{Total} = 4739$
 $Tiempo_{Total} = 7:15min$



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Spine Mts. HybridArc vs. IMRT



SBRT Vertebrae **ELEMENT**



Element Spine



SRS - SPINE SRS



DICOM Viewer



Image Fusion



Spine Curvature
Correction



Anatomical Mapping



SmartBrush



Object Manipulation



Spine SRS



Patient Specific QA

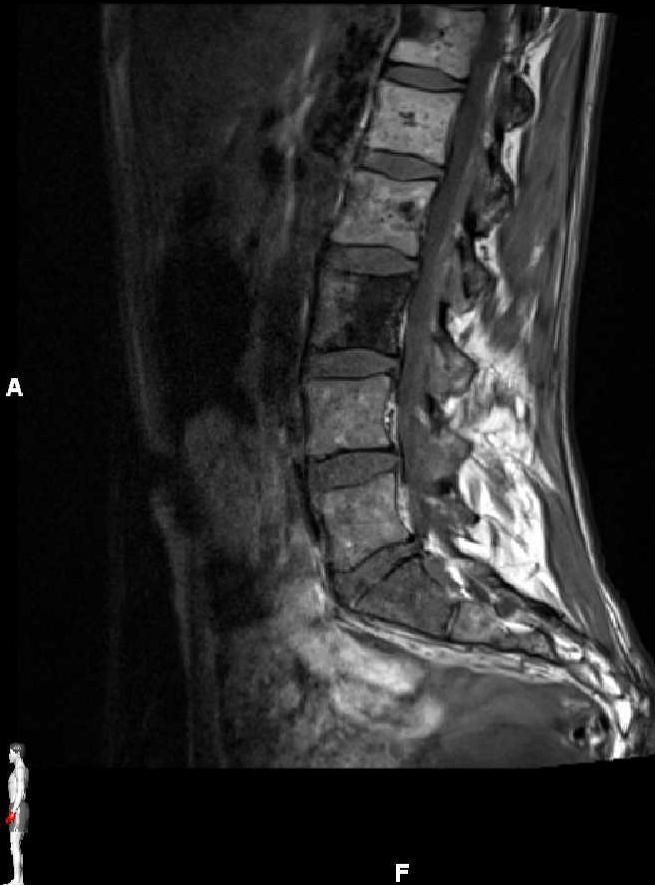
WS 3.0 MPR
Sagittal Slice 28 (of 54)

7/31/2014, 9:30 AM



sag T1 tse 384
Sagittal Slice 10 (of 19)

8/22/2014, 4:45 PM



Alerts Data Home

DICOM Viewer

Scroll

Zoom

Pan

View

Measure

3D Options

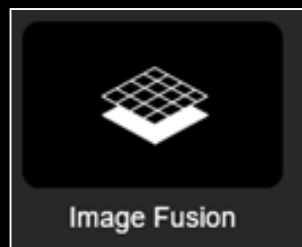
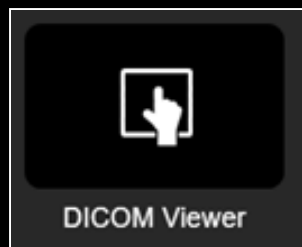
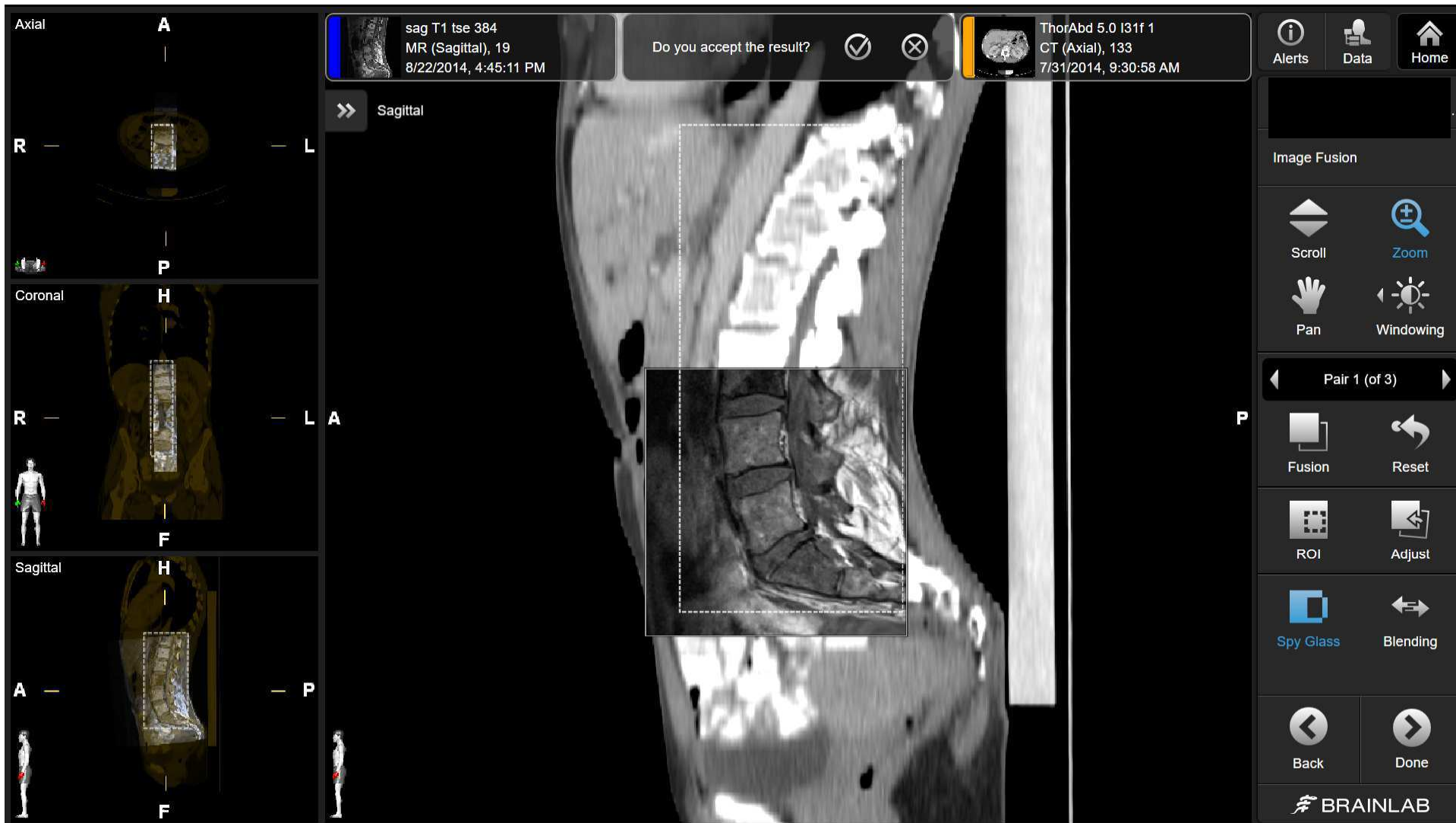
Back

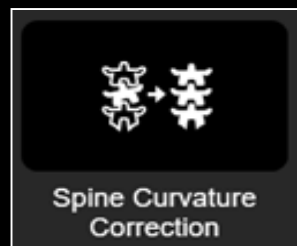
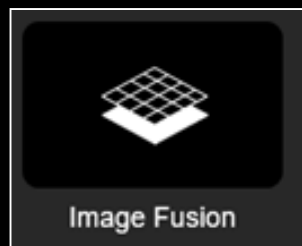
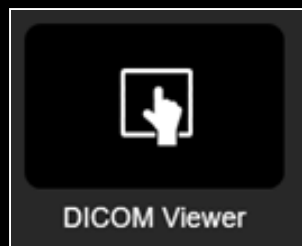
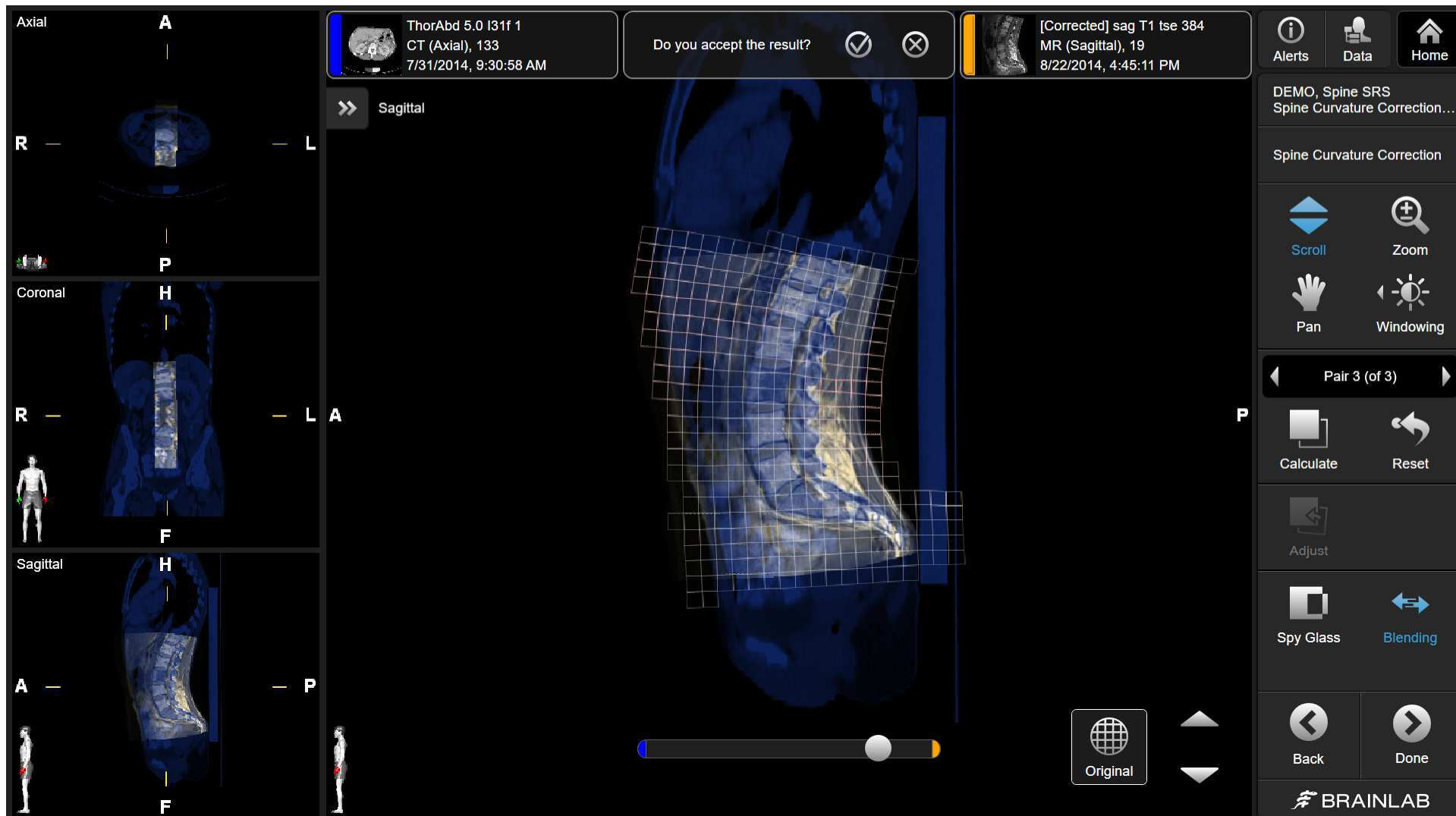
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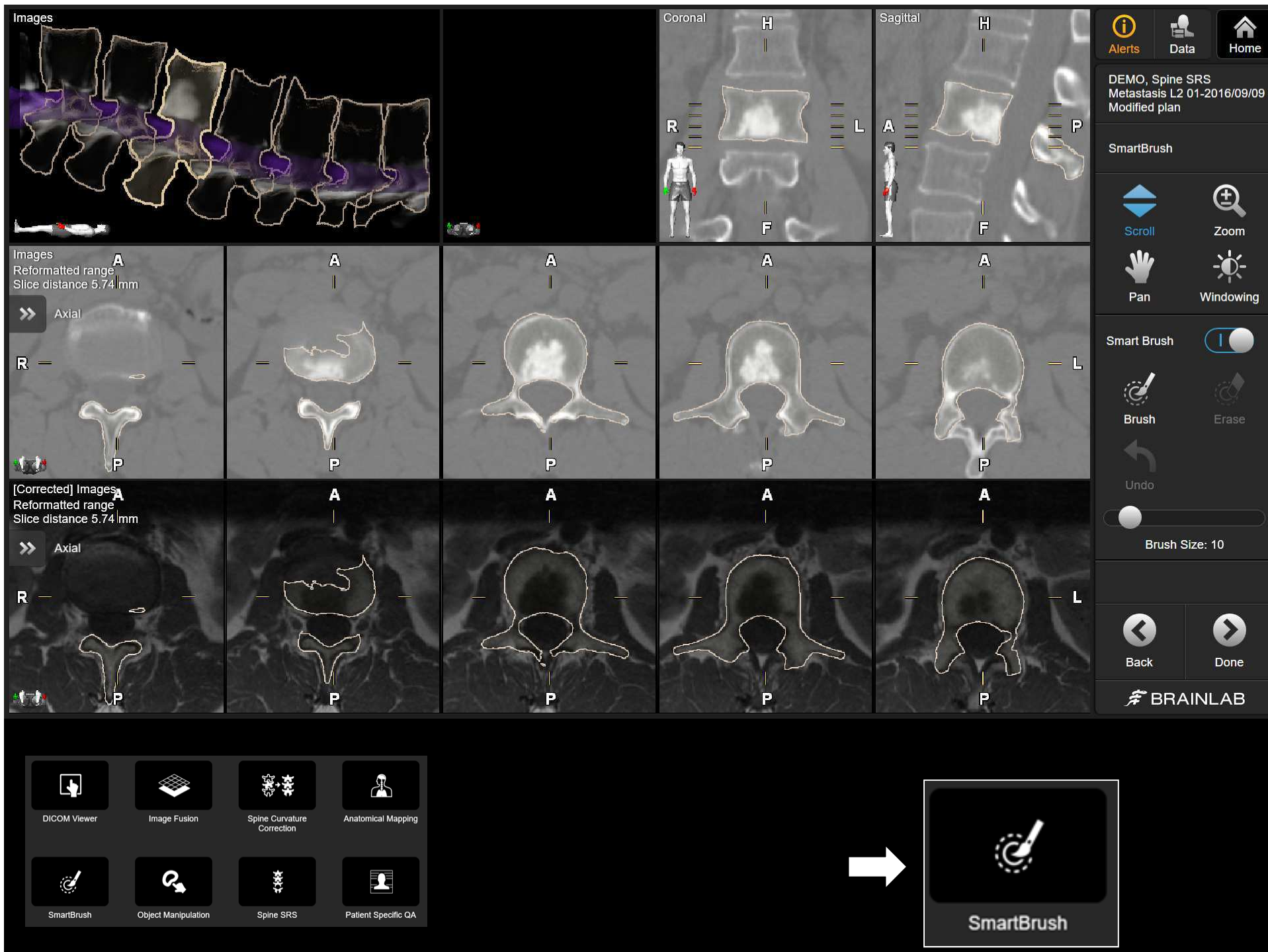
BRAINLAB

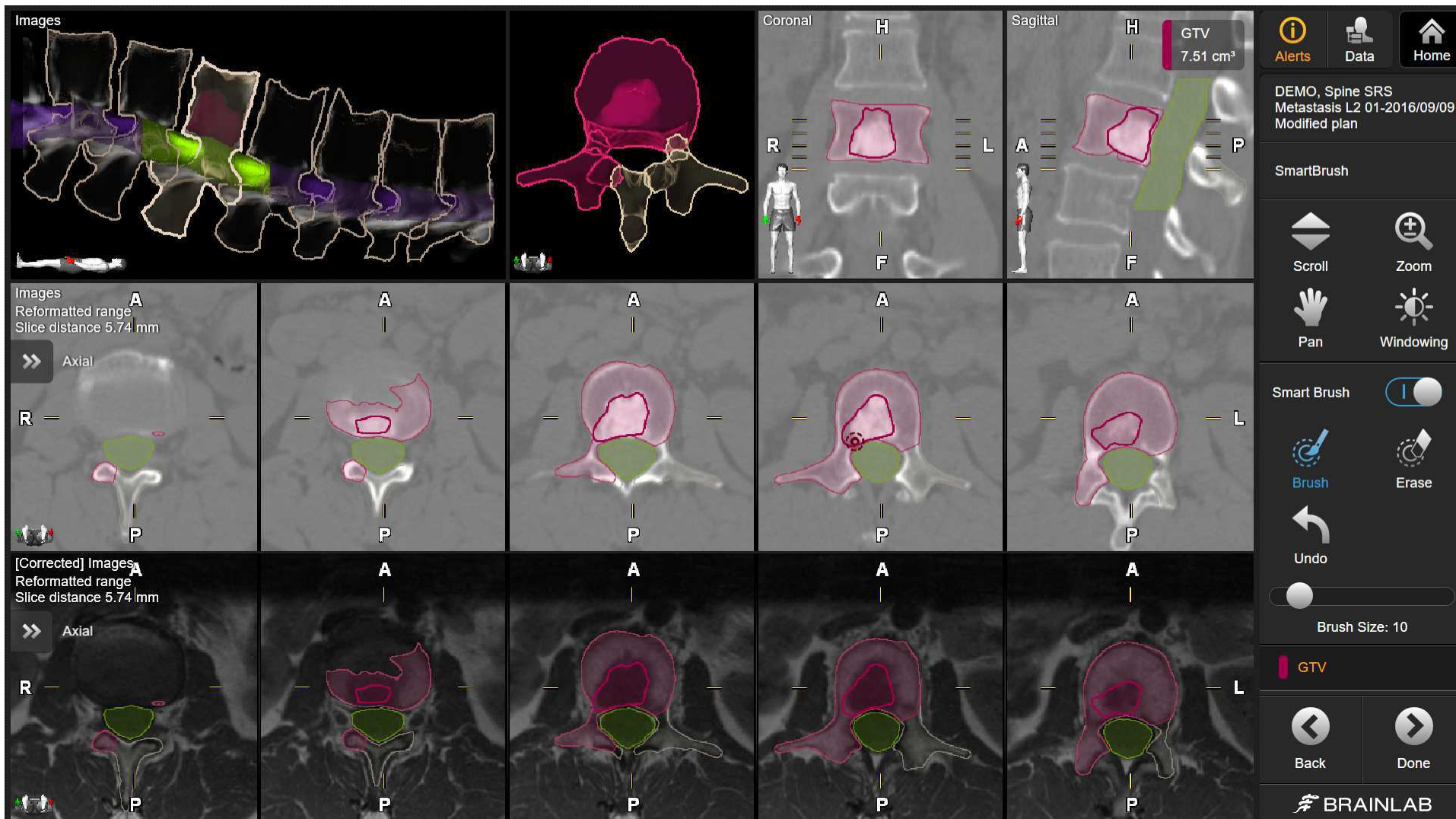


DICOM Viewer

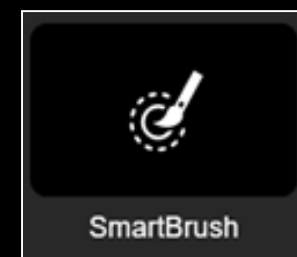




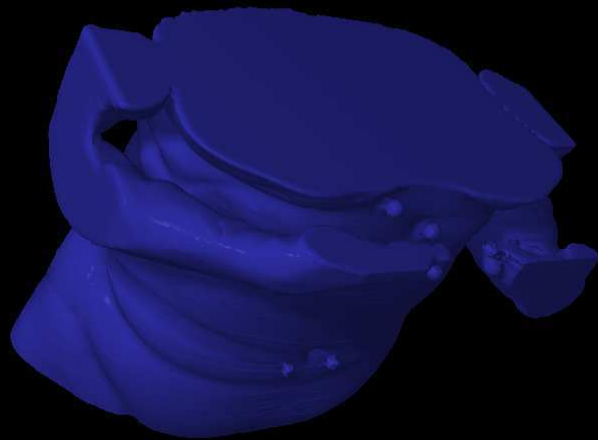




*Cox et al. International Spine Radiosurgery Consortium Consensus Guidelines for Target Volume Definition in Spinal Stereotactic Radiosurgery. International Journal of Radiation Oncology • Biology • Physics. 2012;83(5):597-605.

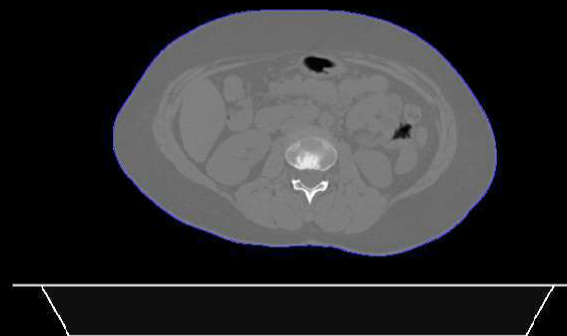


Outer Contour



Tissue Model
Axial

A



R

L

Tissue Model
Coronal

P

H



P R

L

Tissue Model
Sagittal

H



A

F

F

Alerts Data Home

DEMO, Spine SRS
Metastasis L2 01-2016/09/09

Plan not saved yet

Spine SRS



Scroll



Zoom



Pan



Windowing



Back



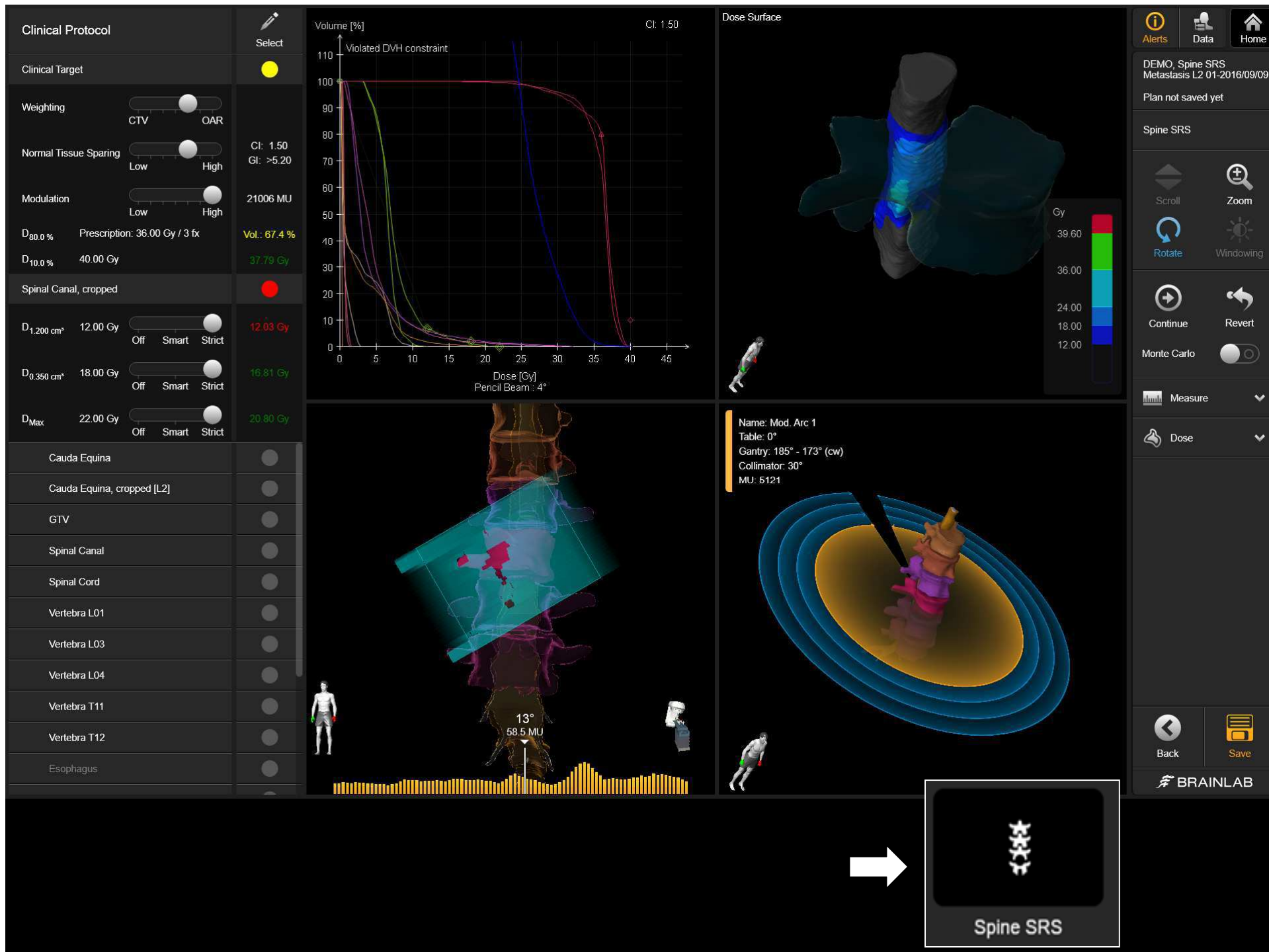
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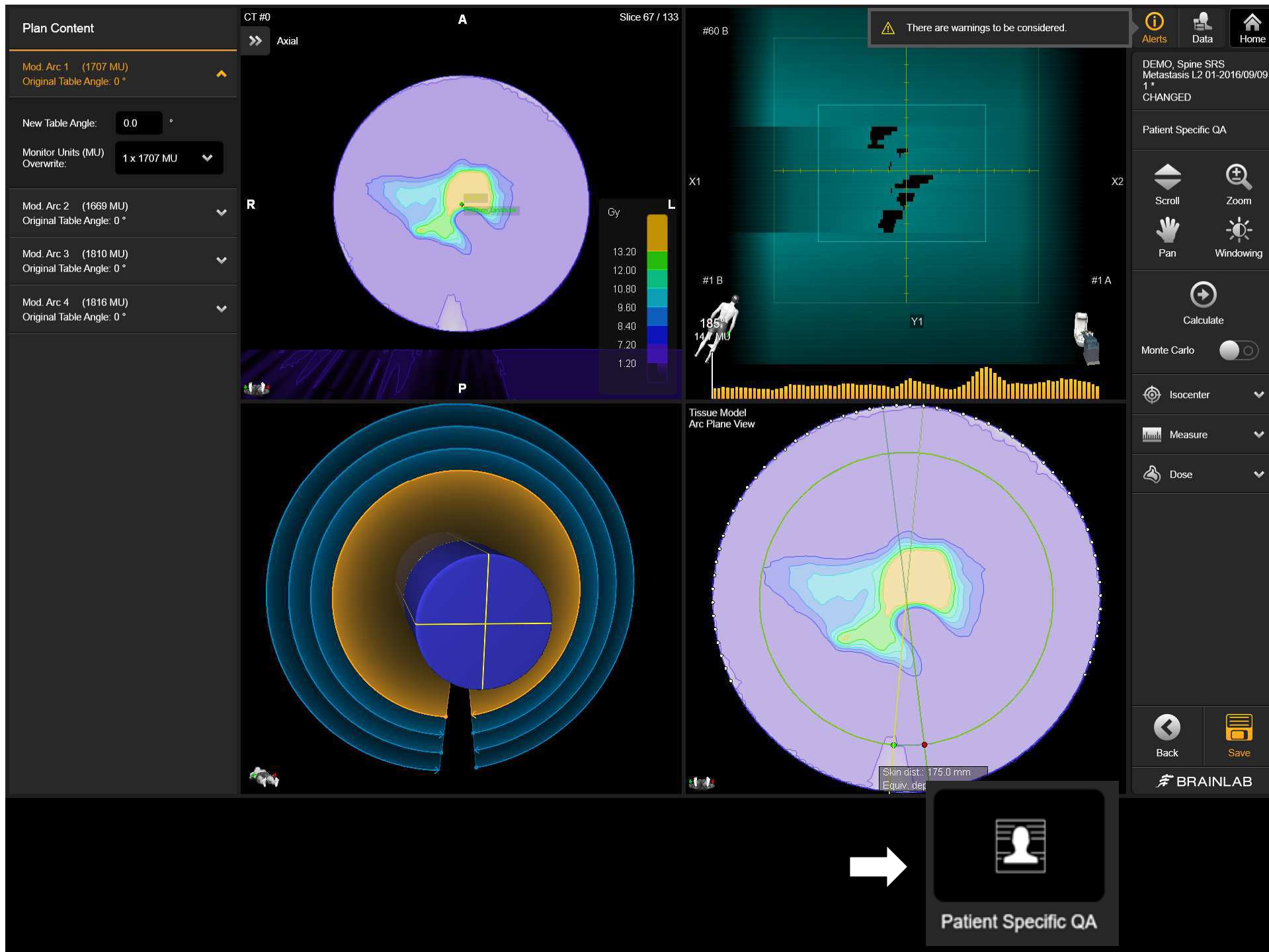
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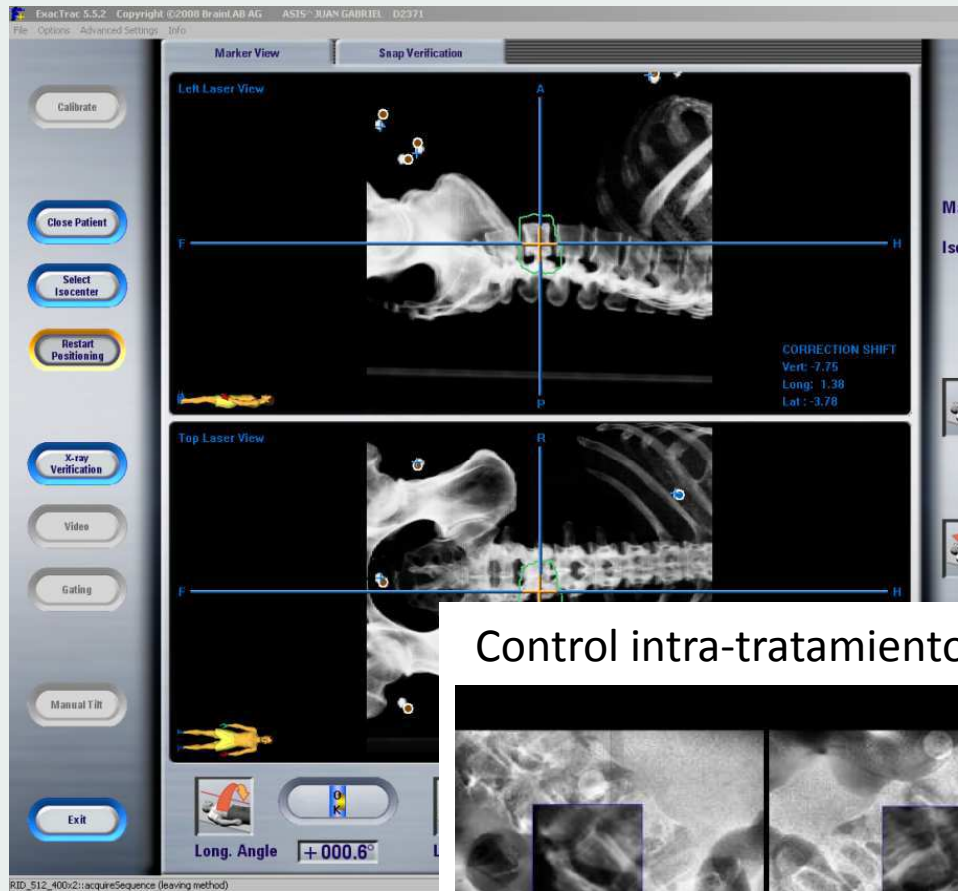
Spine SRS



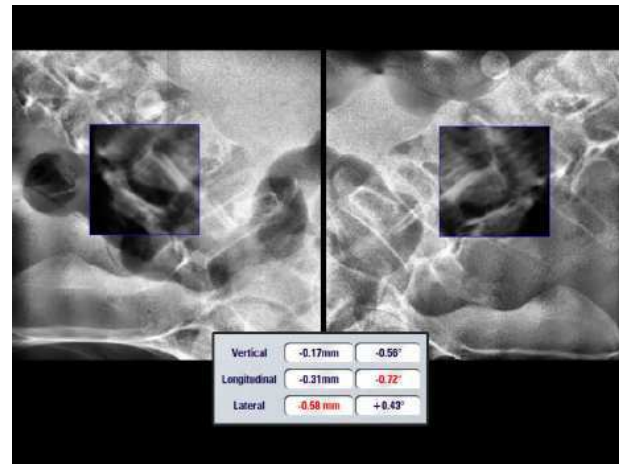




IGRT en SBRT de vertebra

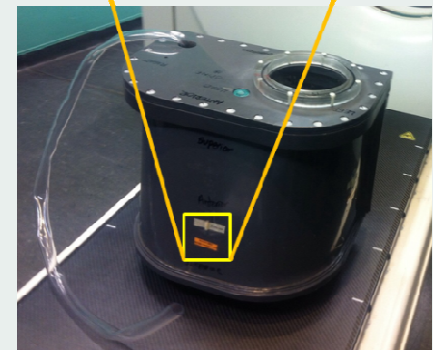
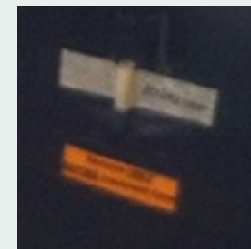
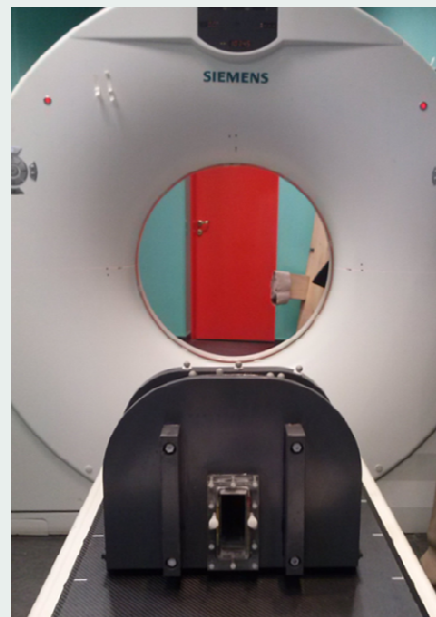
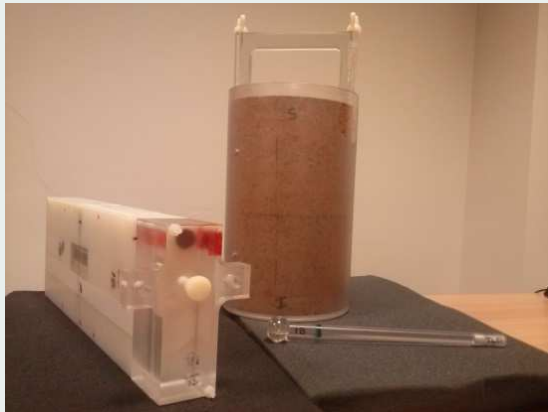
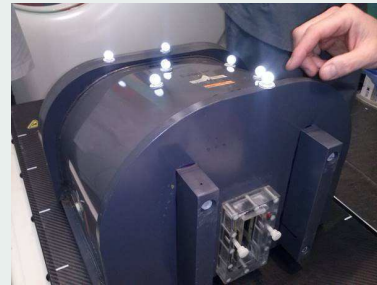


Control intra-tratamiento



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SBRT columna: End-to-End TEST



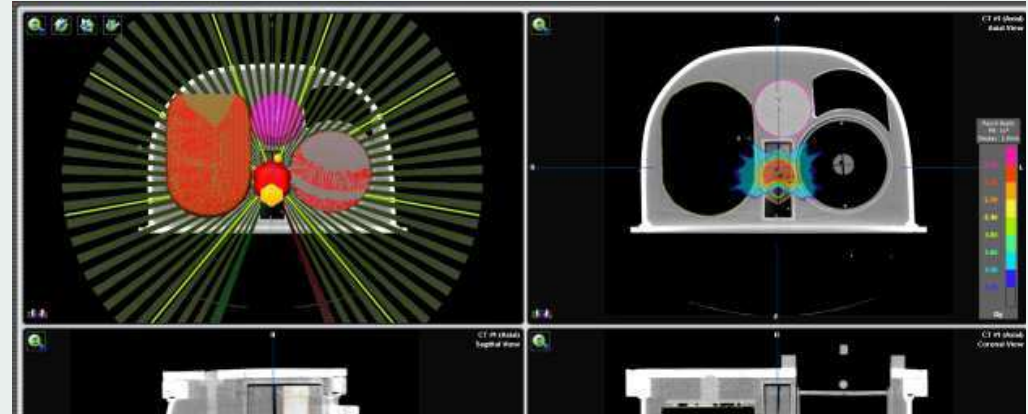
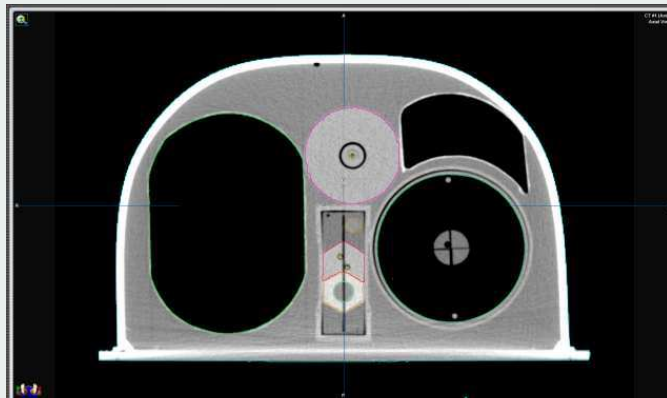
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SBRT columna: End-to-End TEST



MONTE CARLO vs. Medida IROC

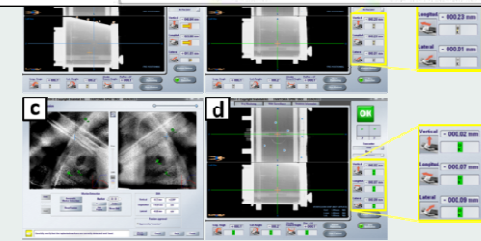
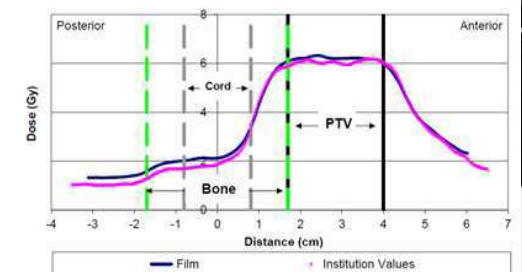
Summary Results:

Location	IROC-H vs. Inst.	Criteria	Acceptable
PTV_TLD_sup_ant	1.02	0.93 – 1.07	Yes
PTV_TLD_inf_ant	1.02	0.93 – 1.07	Yes
PTV_TLD_sup_post	1.00	0.93 – 1.07	Yes
PTV_TLD_inf_post	1.01	0.93 – 1.07	Yes

Film Plane	Gamma Index*	Criteria	Acceptable
Axial	95%	≥85%	Yes
Sagittal	99%	≥85%	Yes

*Percentage of points meeting gamma-index criteria of 5% and 3 mm.

Anterior Posterior Profile



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Conclusiones

- **SBRT columna** es un tratamiento que
 - Requiere de exactitud milimétrica (MLC de alta resolución)
 - IGRT inicial y control intratratamiento
 - Requiere de un corto tiempo de tratamiento
- **ELEMENT** es un flujo de trabajo que incluye
 - Corrección de RNM por curvatura para fusión elástica con CT
 - Segmentación automática de OAR
 - Delimitación de GTV y CTV automático basado en guía internacional
 - Planificación automática basada en Protocolos
 - Tratamiento VMAT dedicado (alto gradiente de dosis)
 - Corto tiempo de tratamiento
 - Control de calidad

