Andrew Cole

Australian Clinical Dosimetry Service

Results from ACDS end-to-end dosimetry audit of spine and lung SBRT

Australian Government
Australian Radiation Protection and Nuclear Safety Agency

RMIT UNIVERSITY

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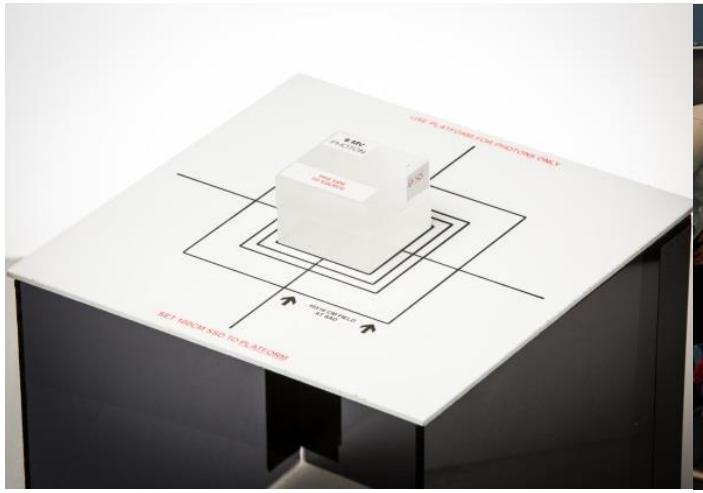
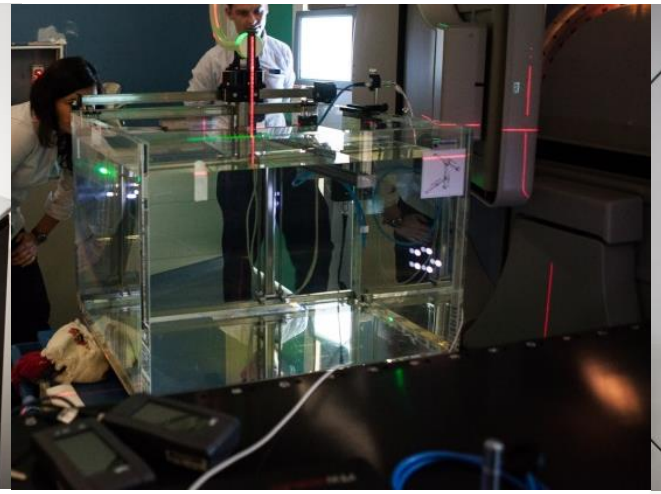
ESTRO Meets ASIA 2019

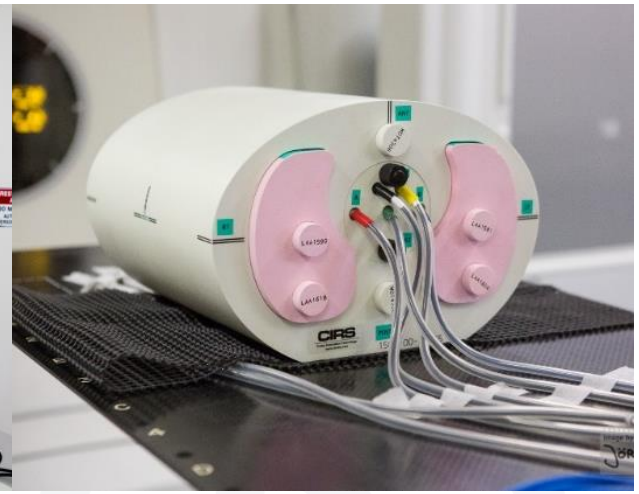
Maddison Shaw, Andrew Alves, Jeremy Supple, Cate Davey, Joerg Lehmann, Rhonda Brown, Fayz Kadeer, John Kenny, Andrew Cole, Jessica Lye

ACDS Audit Structure

Level I	Level I	Level II	Level III
OSLD	Ion chamber, micro-diamond	2D Array	Ion chambers, film, micro-diamond







Output check (mail out)	Output check (onsite)	Test of TPS (onsite)	End-to-end test (onsite)

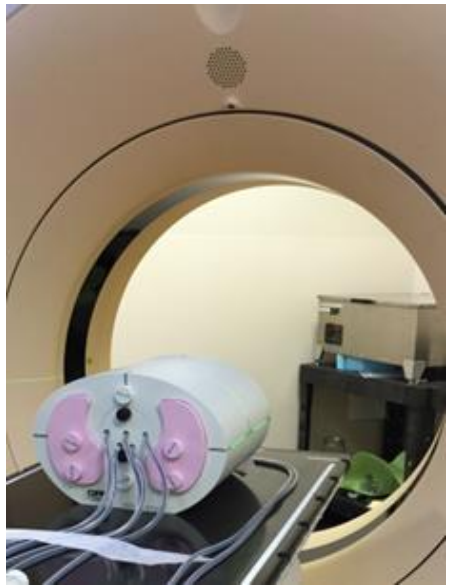
Physics

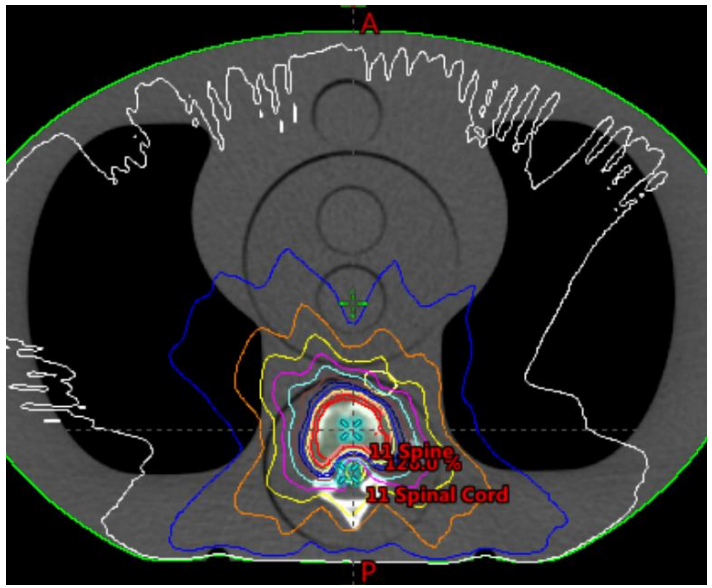
Physics & Radiation Therapists

SABR audit

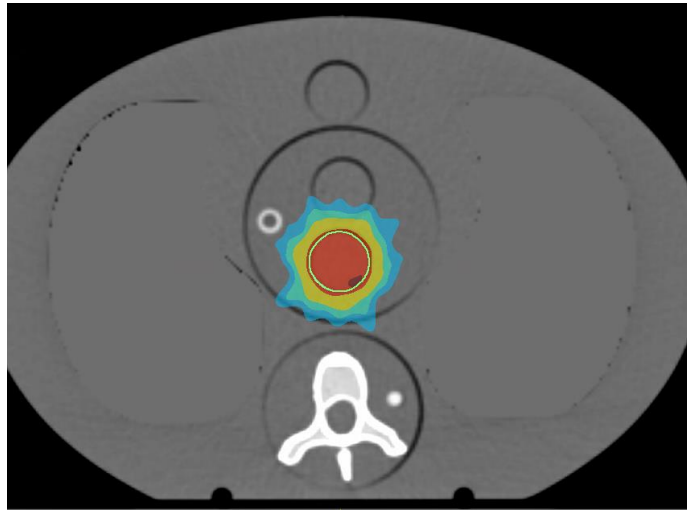
End-to-end test

3DCRT, IMRT, VMAT, **SABR**



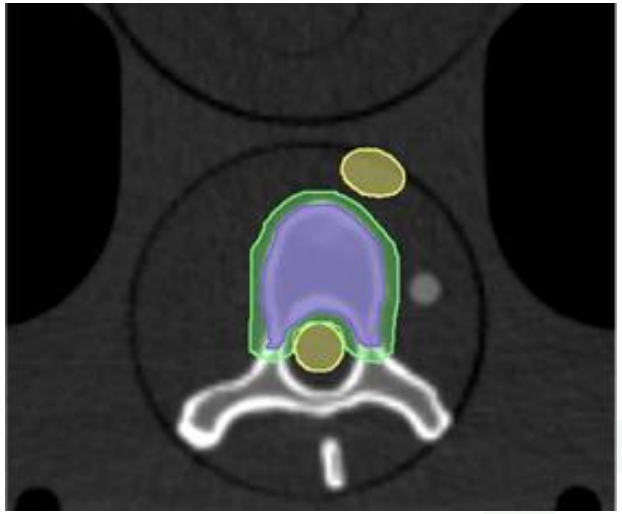


Treatment Cases



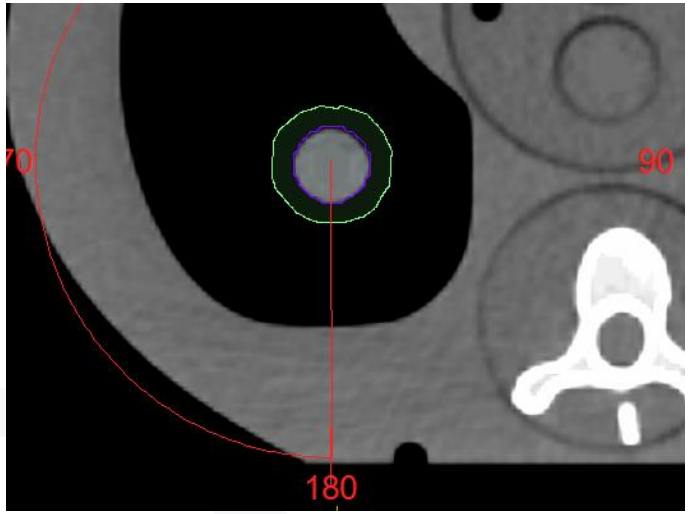
Soft Tissue

- Simple 2.5 cm cylindrical target
- Delivered to (mostly) homogenous phantom
- Transverse film + point dose at centre PTV
- 45 Gy / 3 #
- Adapted from ICR/TROG 16.03 Core Trial for Liver SABR



Spine

- Adapted from SC24 SABR Spine Trial
- 24 Gy / 2 #
- Transverse film
  - → CIRS Cortical Bone, density = 1.91 g/cc
  - → CIRS Trabecular Bone, density = 1.197 g/cc
- Point dose measurements
  - → PTV (CIRS Trabecular Bone)
  - → Spinal Cord (CIRS Spinal Cord)



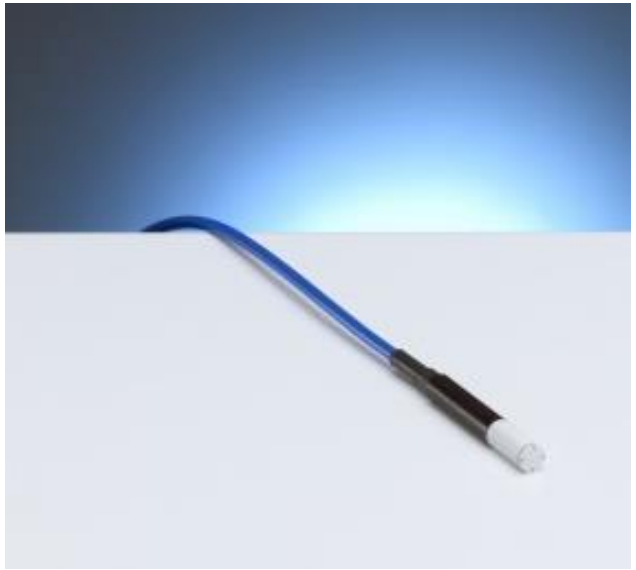
Lung

- 2 cm lung tumour treated with ITV approach
- Coronal film + point dose at centre ITV
- 48 Gy / 4 #
- Adapted from TROG 13.01 SAFRON II for 4#
- No motion in Ph1 (planned for 2020)

Detectors

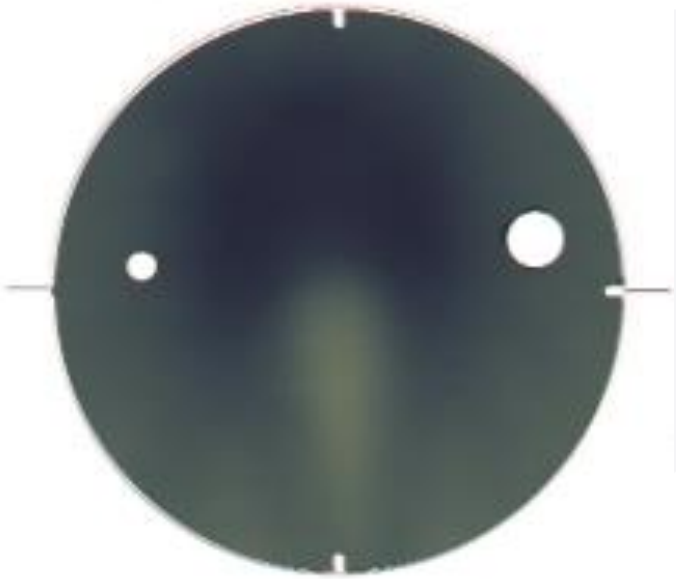
microDiamond Point Dose

- Cross calibrated to CC13
- Perpendicular orientation
- TRS-483 field size corrections
- Calibrated dose-to-water (D_w)



Gafchromic Film

- Dose dependent darkening
- Absolute dose in FilmQAPro
- Analysis in Matlab
- Calibrated dose-to-water (D_w)



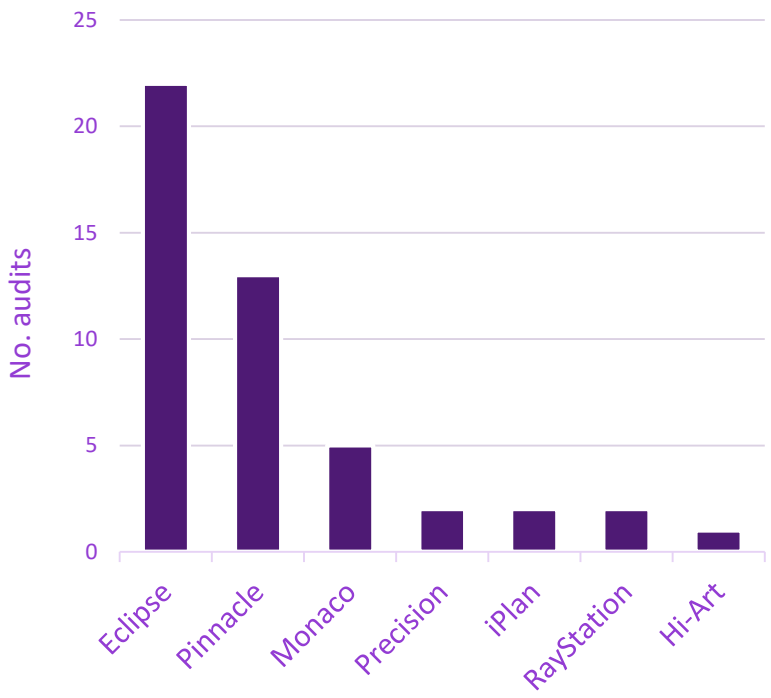
Proposed scoring criteria

		Pass (Optimal Level)	Pass (Action Level)	Out of Tolerance
Gamma Criteria Relative to Px dose <10% dose suppressed		5%/2mm ≥ 95%	5%/2mm < 95% and ≥ 90%	5%/2mm < 90%
1D profile DTA	70% isodose soft tissue and lung	-	-	> 3.0 mm
	50% isodose Spine/Spinal Cord junction			> 1.5 mm
Point dose		-	-	> 8%

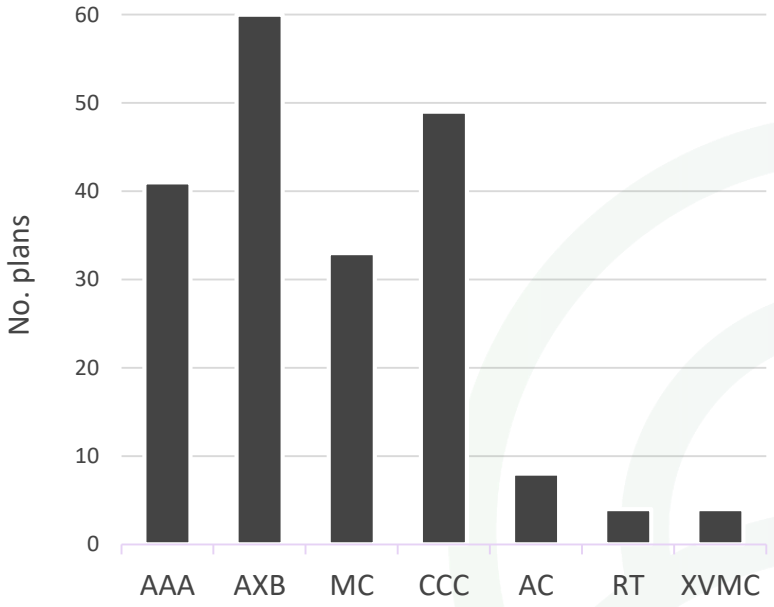
Audits Completed

42 audits
194 plans

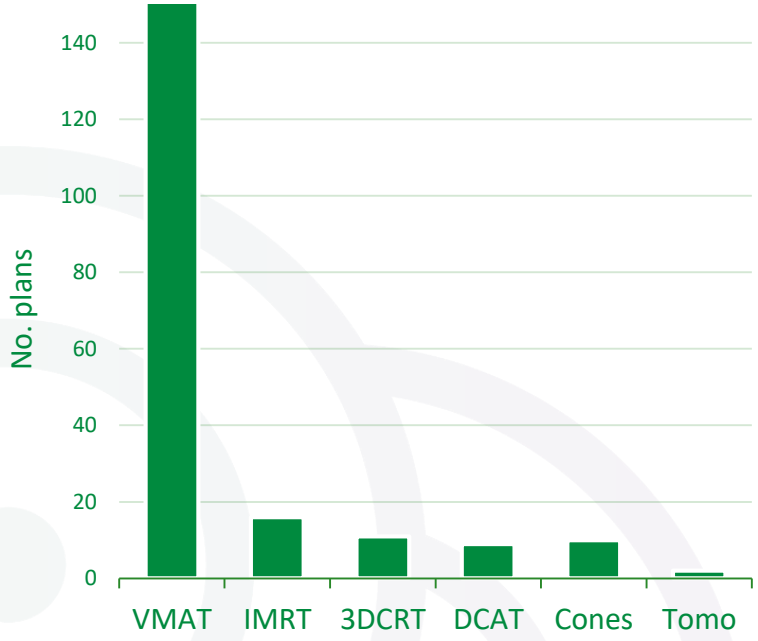
Treatment Planning Systems



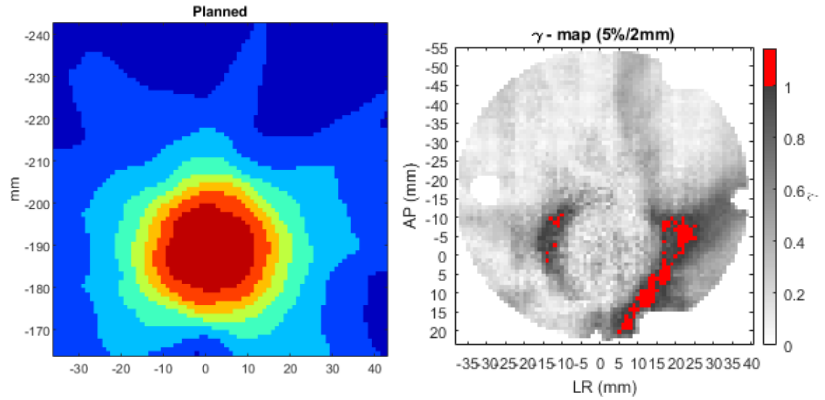
Algorithms

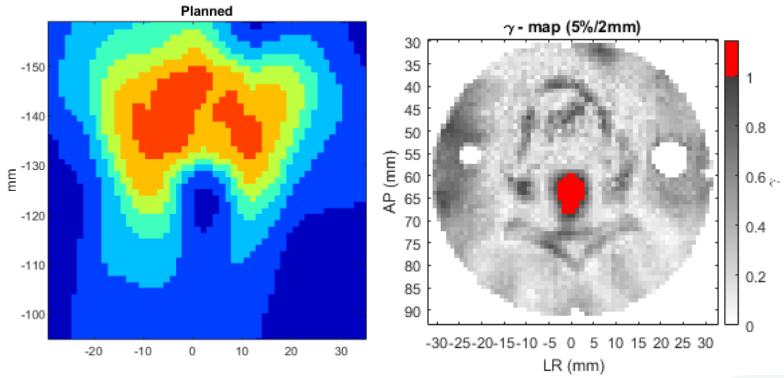


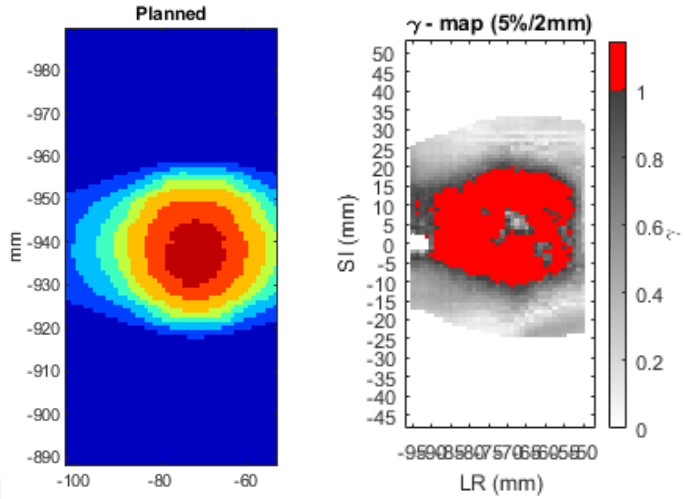
Modalities



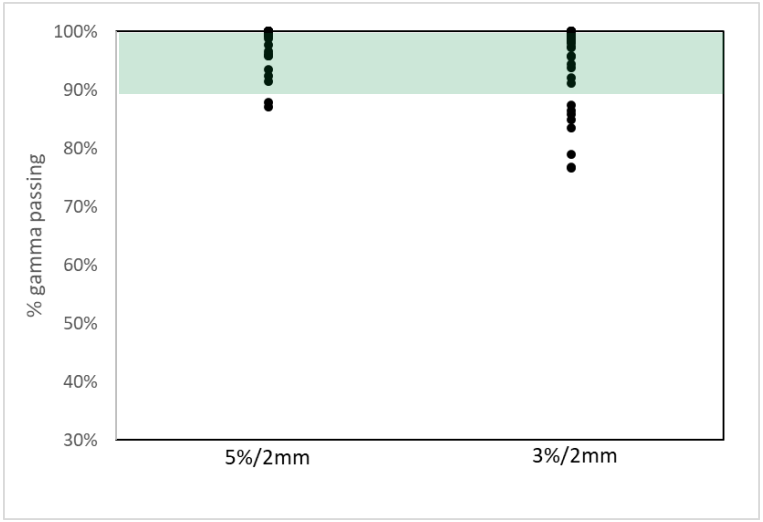
Film – Gamma results



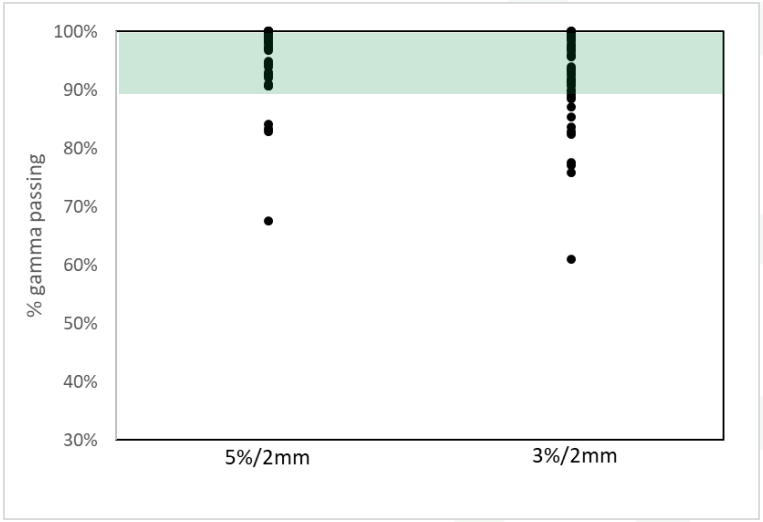




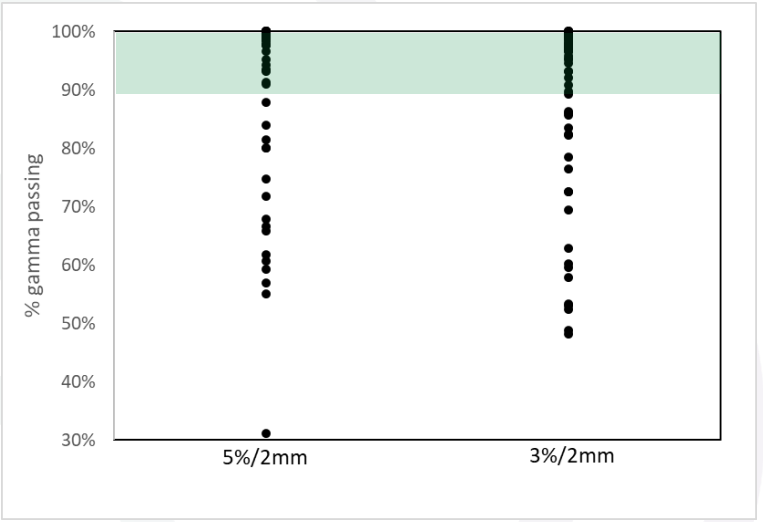
Soft Tissue



Spine

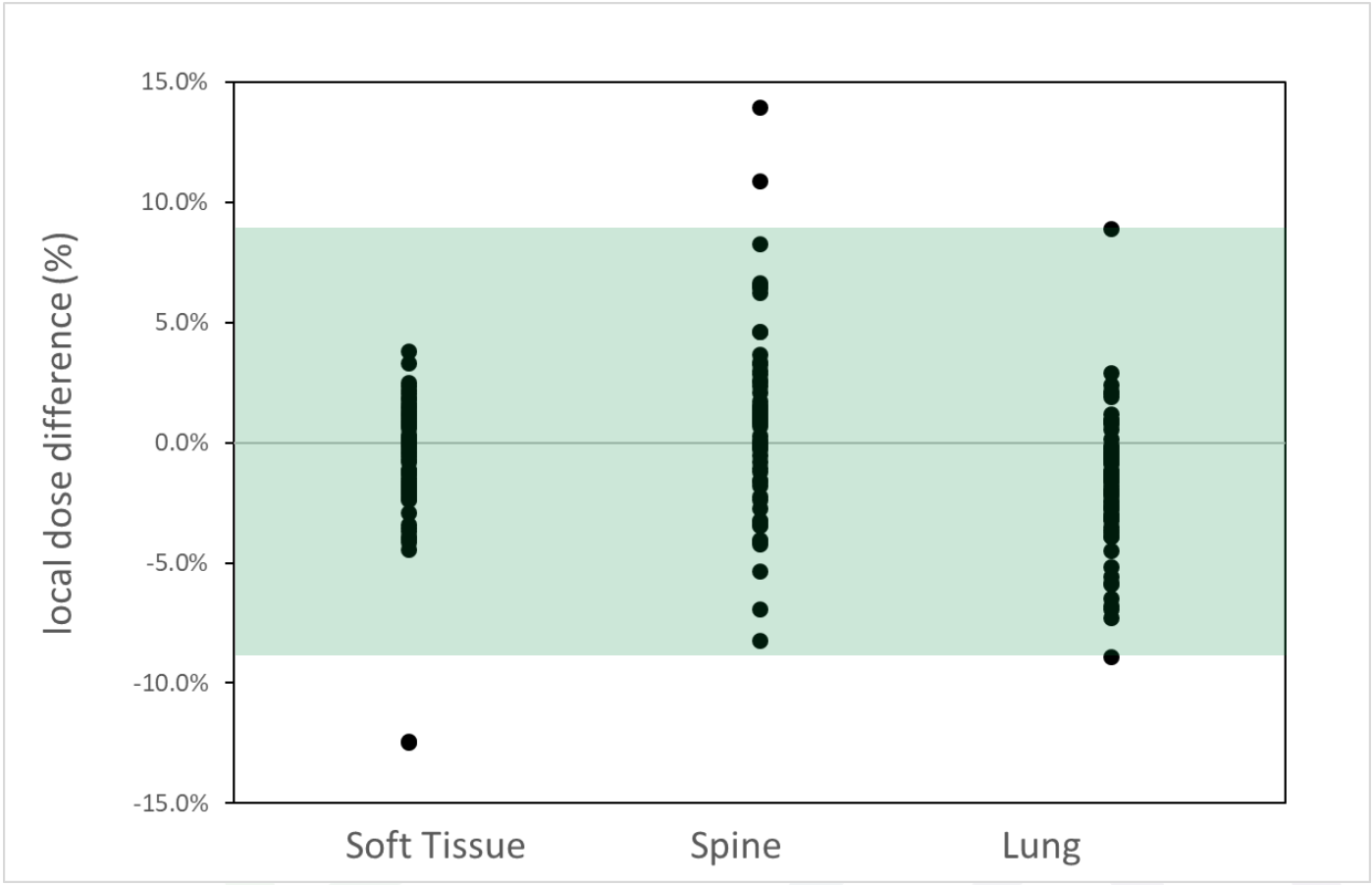


Lung



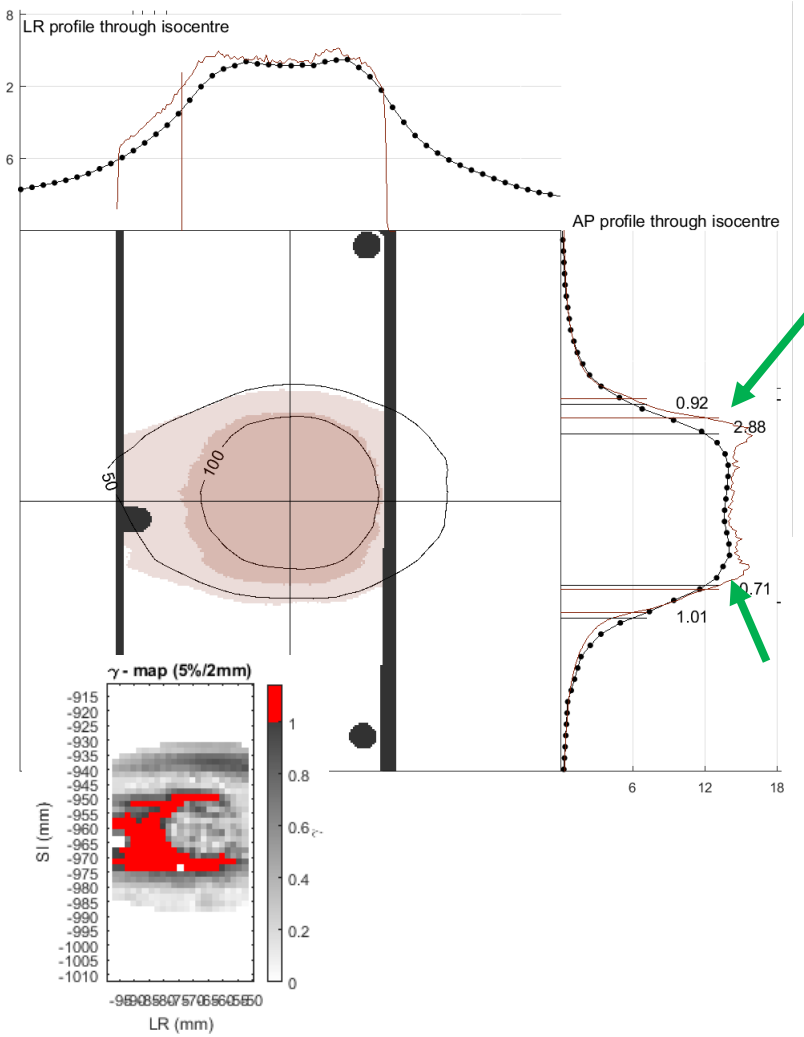
microDiamond - Point dose

- Bias in soft tissue and lung
- Not seen in reference fields, confident in absolute dosimetry
- Spine is dose to bone corrected, correction factors not finalised

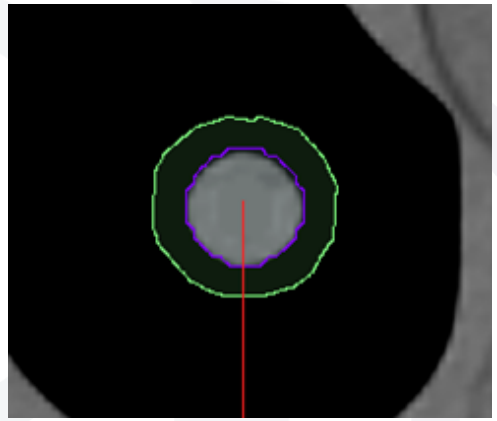


	Soft Tissue	Spine	Lung
Average	***-0.3%***	***0.2%***	***-1.8%***
St Dev	***2.8%***	***4.1%***	***2.8%***

Lung

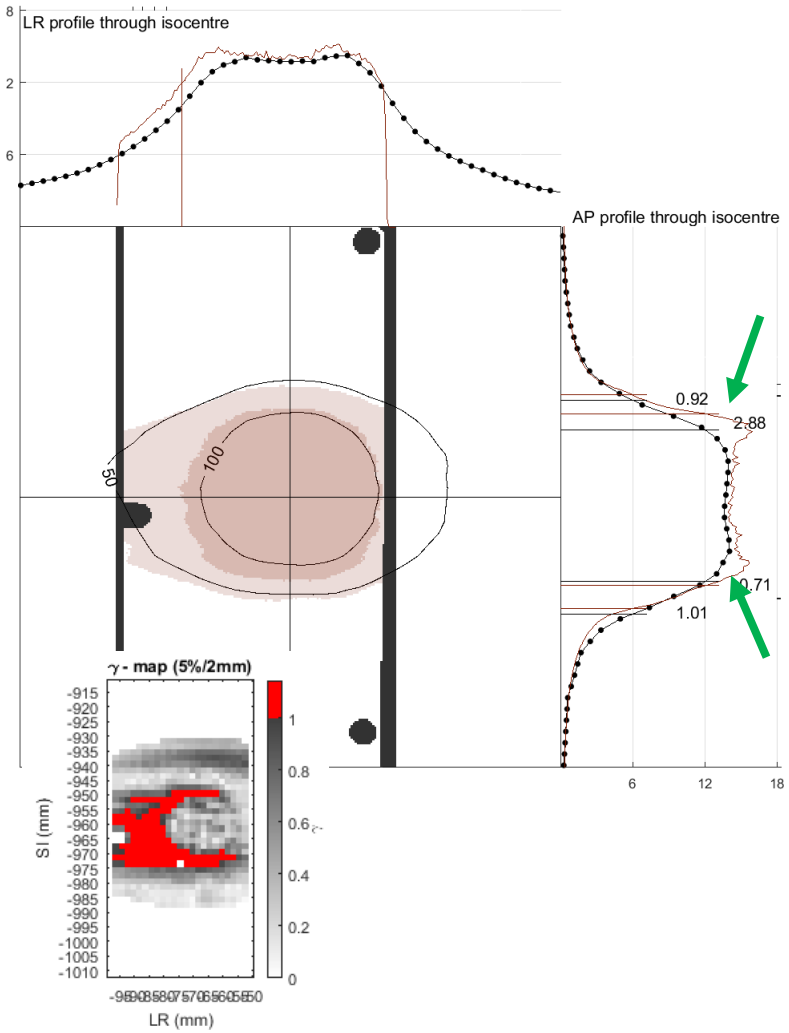


- Tumour in phantom has more defined interface than typical lung tumours
- See a ring of plan underdose at tumour/lung interface
- Theory: TPS not modelling the long range electrons from lung-target interface
- Across algorithms
- Further Monte Carlo work TBC

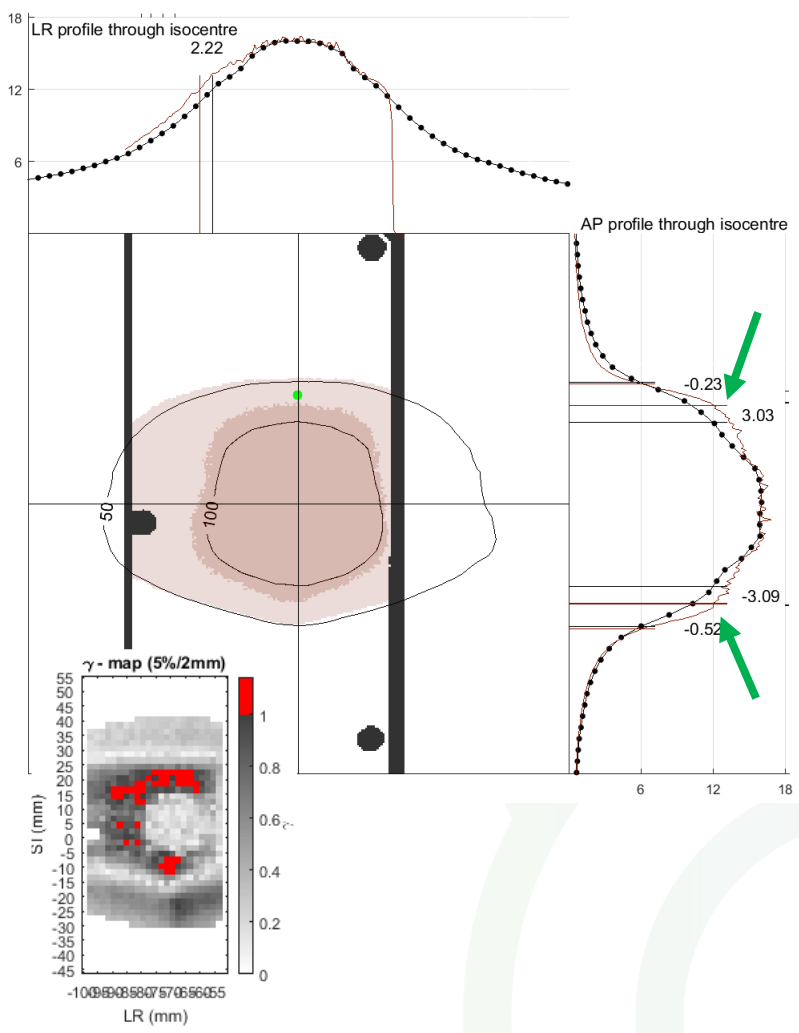


Lung

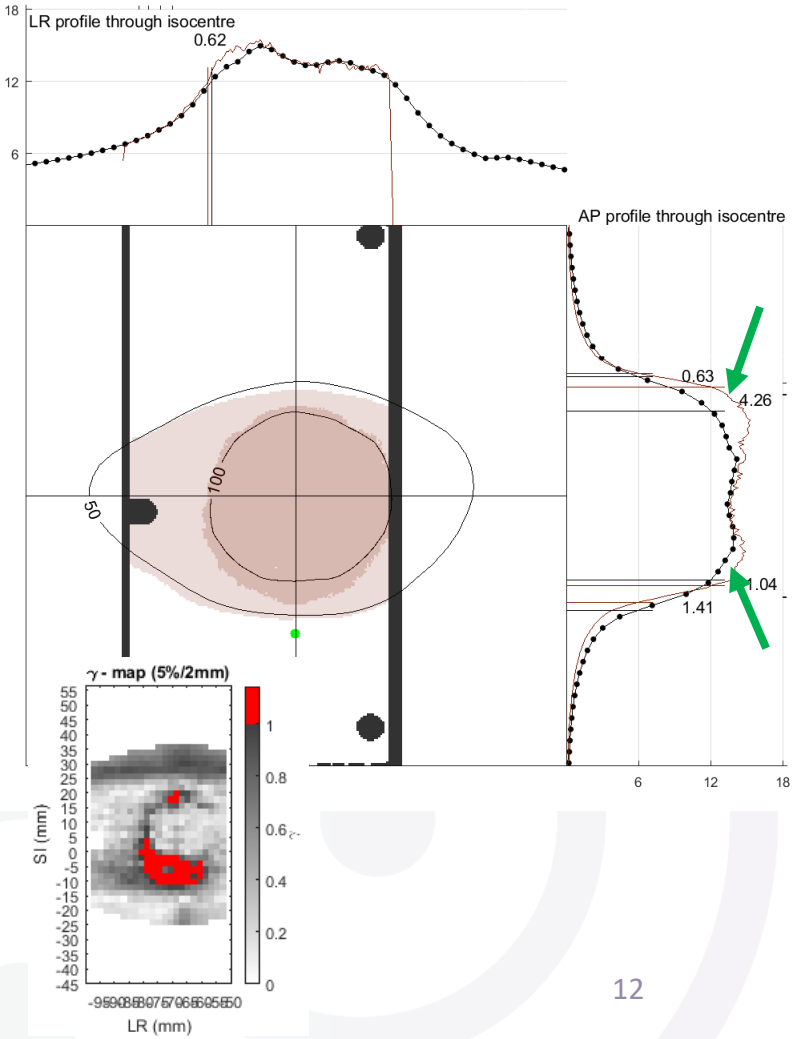
AXB



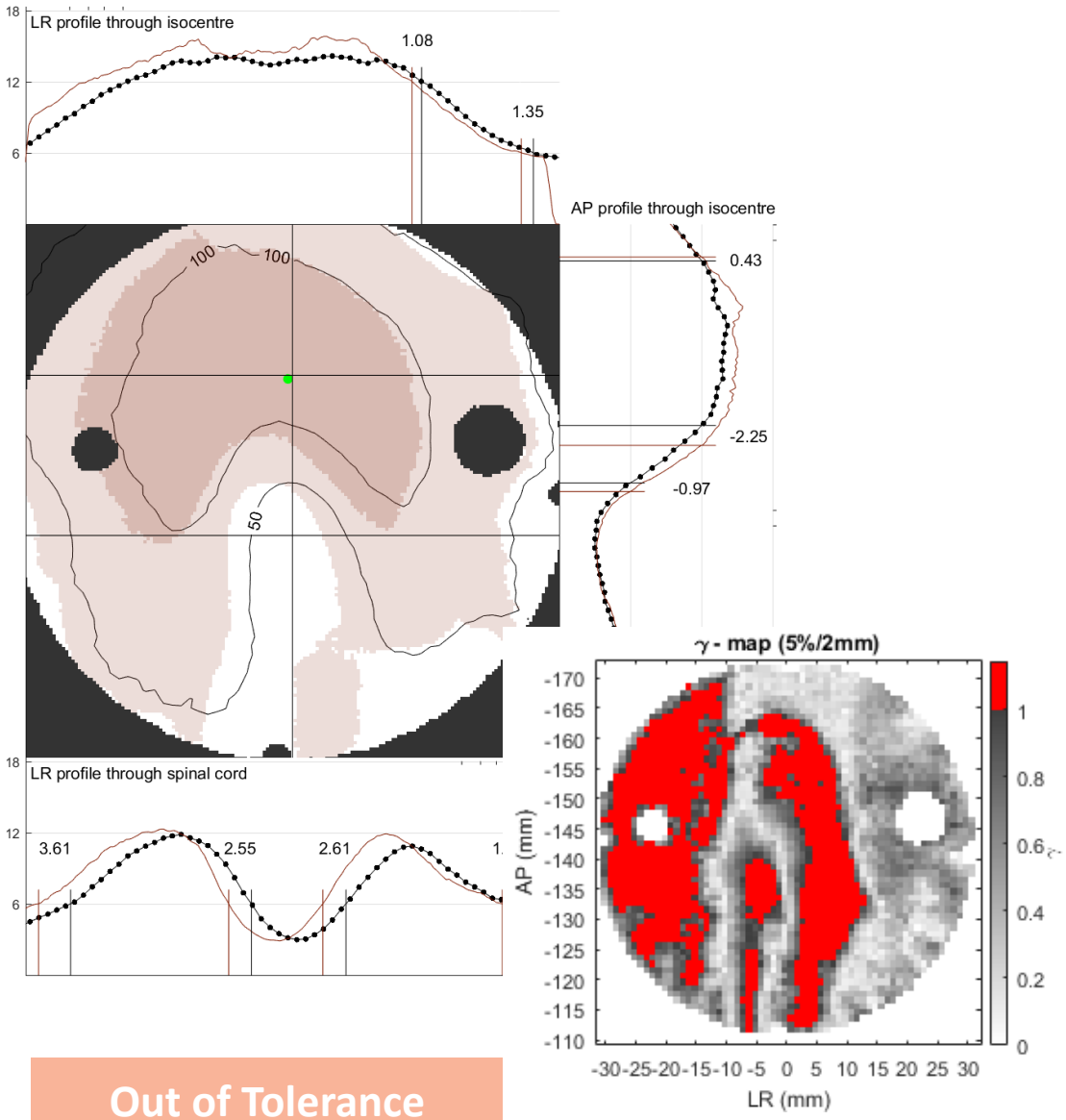
MC



CCC



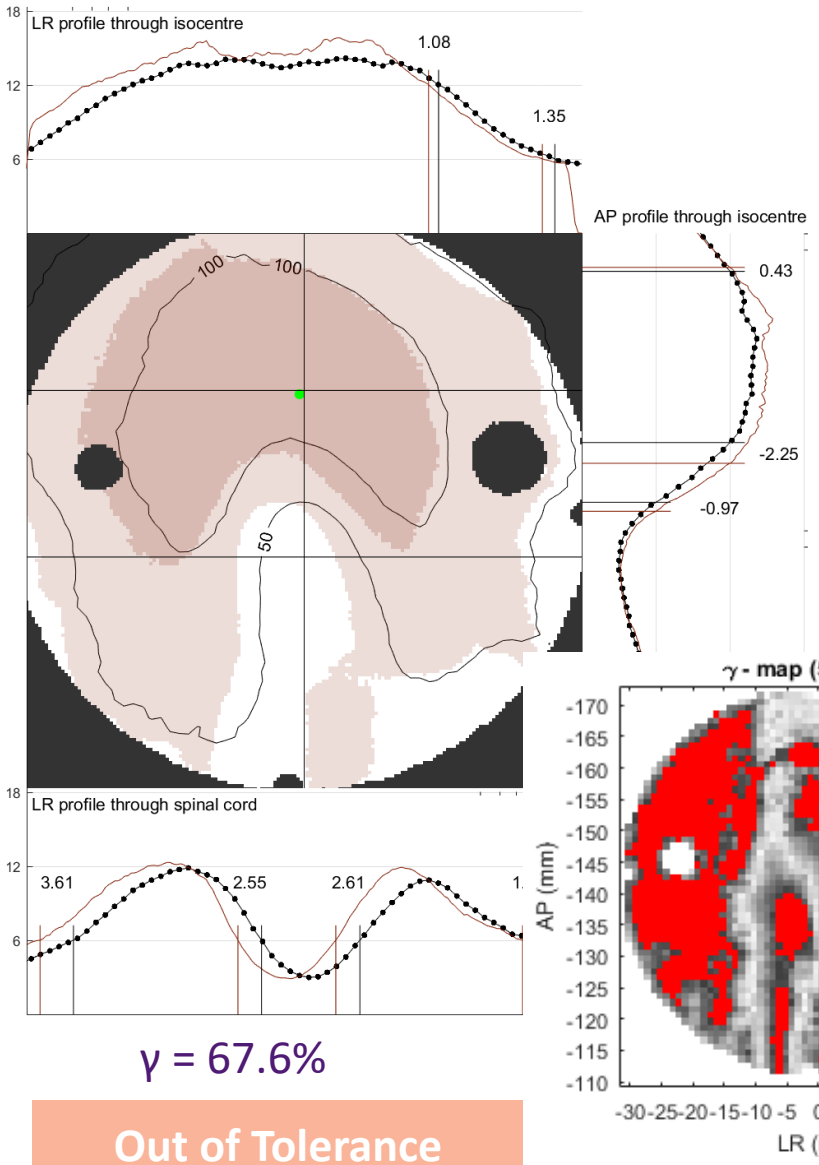
SABR Case Study 1



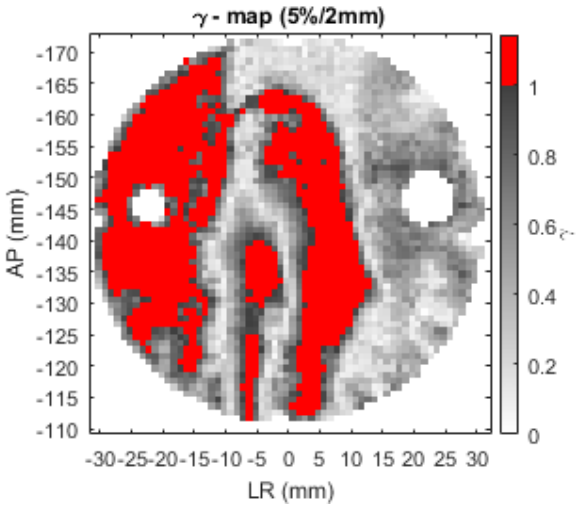
Out of Tolerance

- Spine offset ~2-3mm in L-R direction, 5%/2mm γ = 67.6%
- FFF beam isocentre was misaligned, particularly for posterior angles
- Plan shown was IMRT 6FFF, heavily weighted posteriorly
- Soft tissue and lung cases both showed good results, but were delivered with VMAT and DCAT
  - Full arc soft tissue, partial arcs lung
- Facility corrected isocentre misalignment
- Repeated audit

SABR Case Study 1

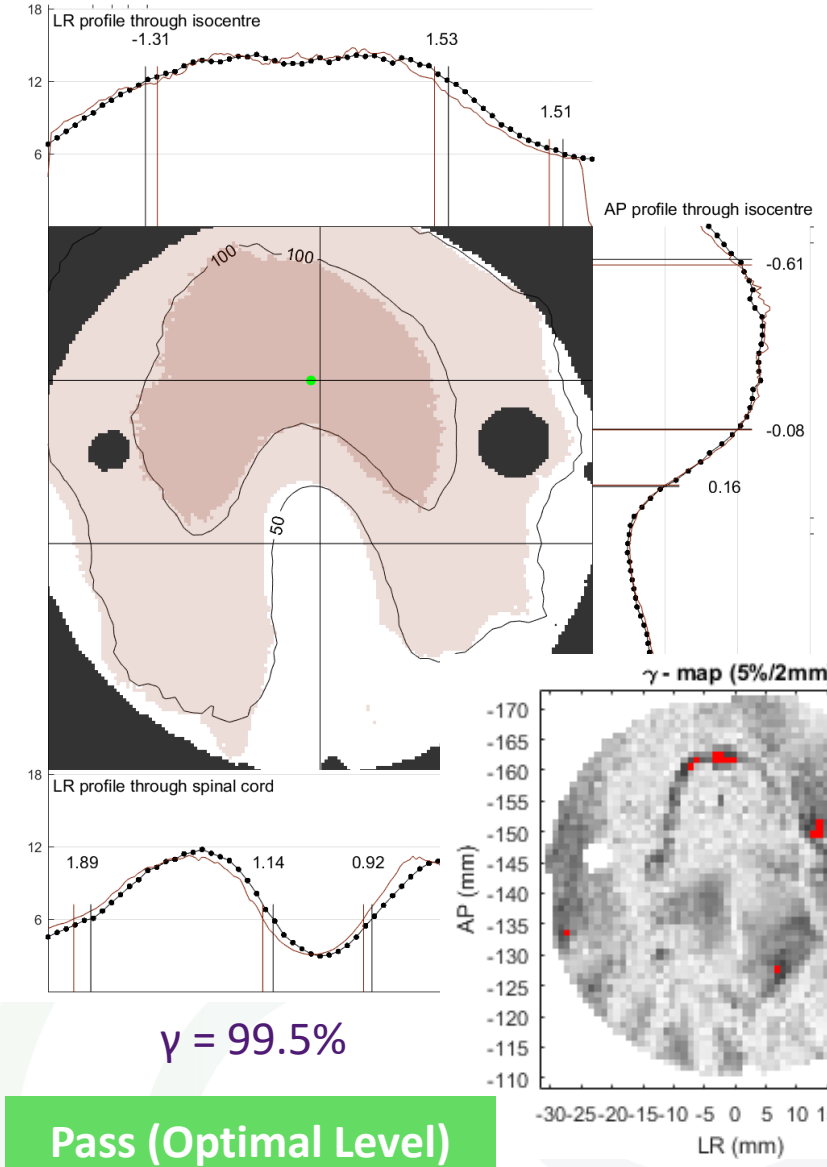


Original audit
6FFF IMRT

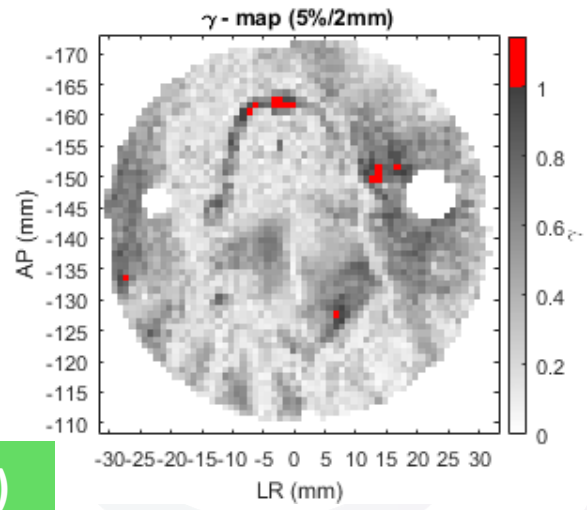


γ = 67.6%

Out of Tolerance



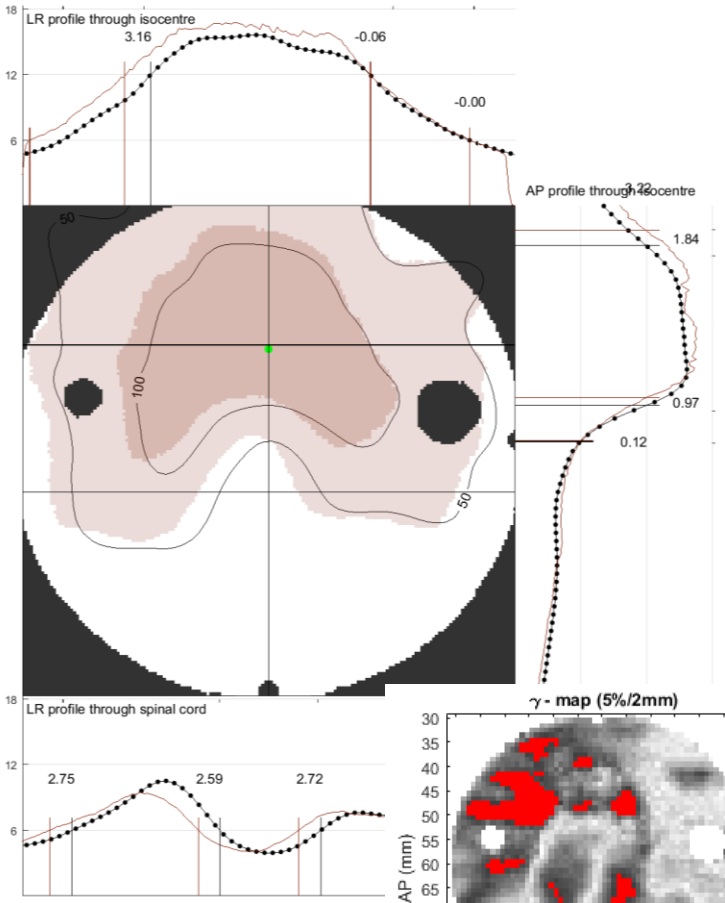
Repeat
measurement
6FFF IMRT

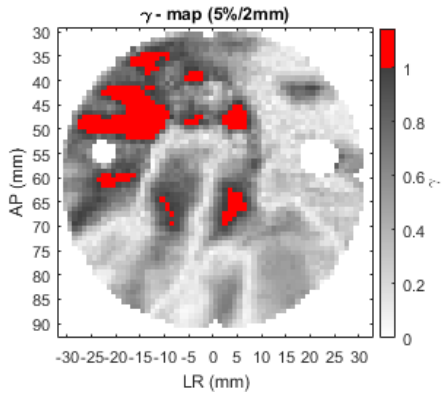


γ = 99.5%

Pass (Optimal Level)

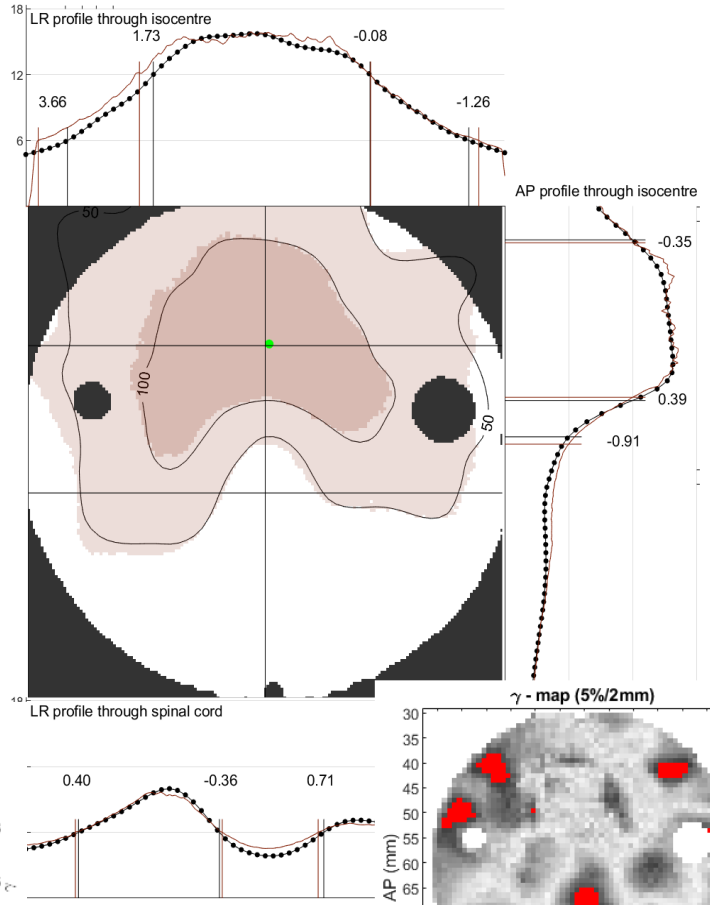
SABR Case Study 2

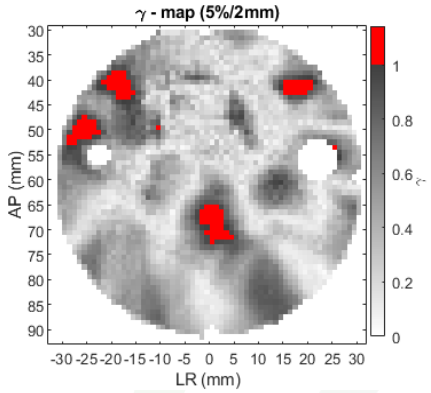




Linac 1
ExacTrac
Original audit
γ = 85.9%

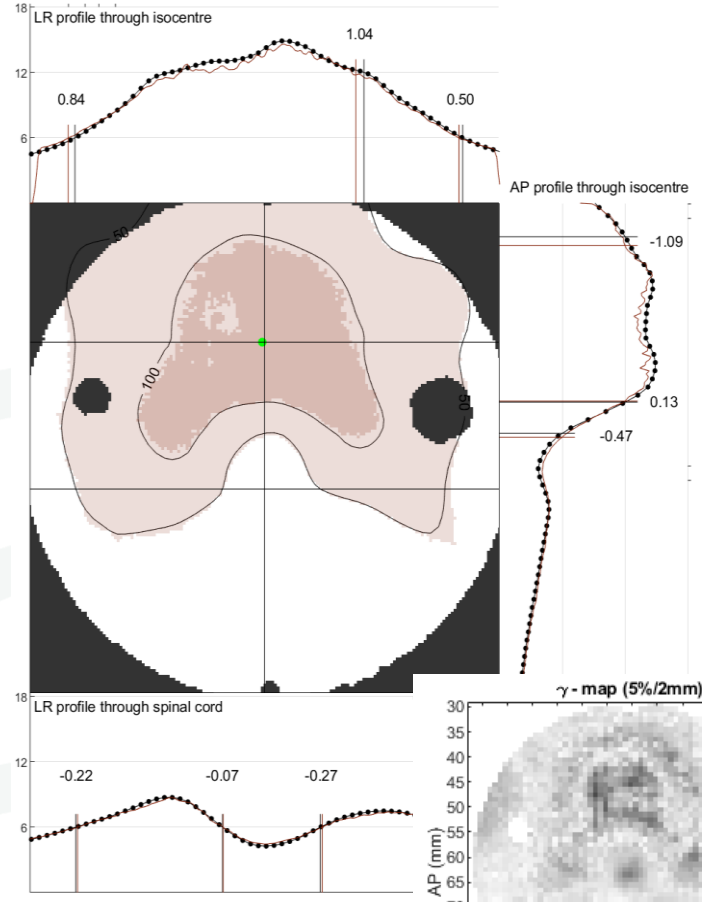
Out of Tolerance





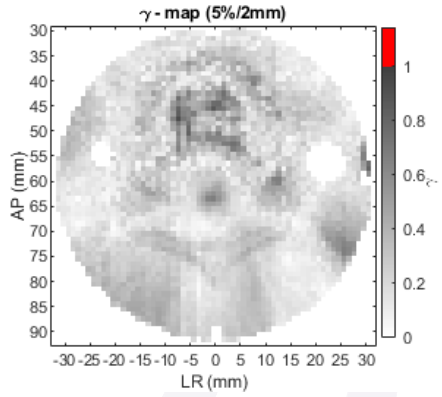
Linac 1
ExacTrac + CBCT
Repeat audit
γ = 96.7%

Pass (Optimal Level)



Linac 2
CBCT

γ = 100%



Pass (Optimal Level)

Thank you

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