Results from 1069 IMRT irradiations of an anthropomorphic head and neck phantom

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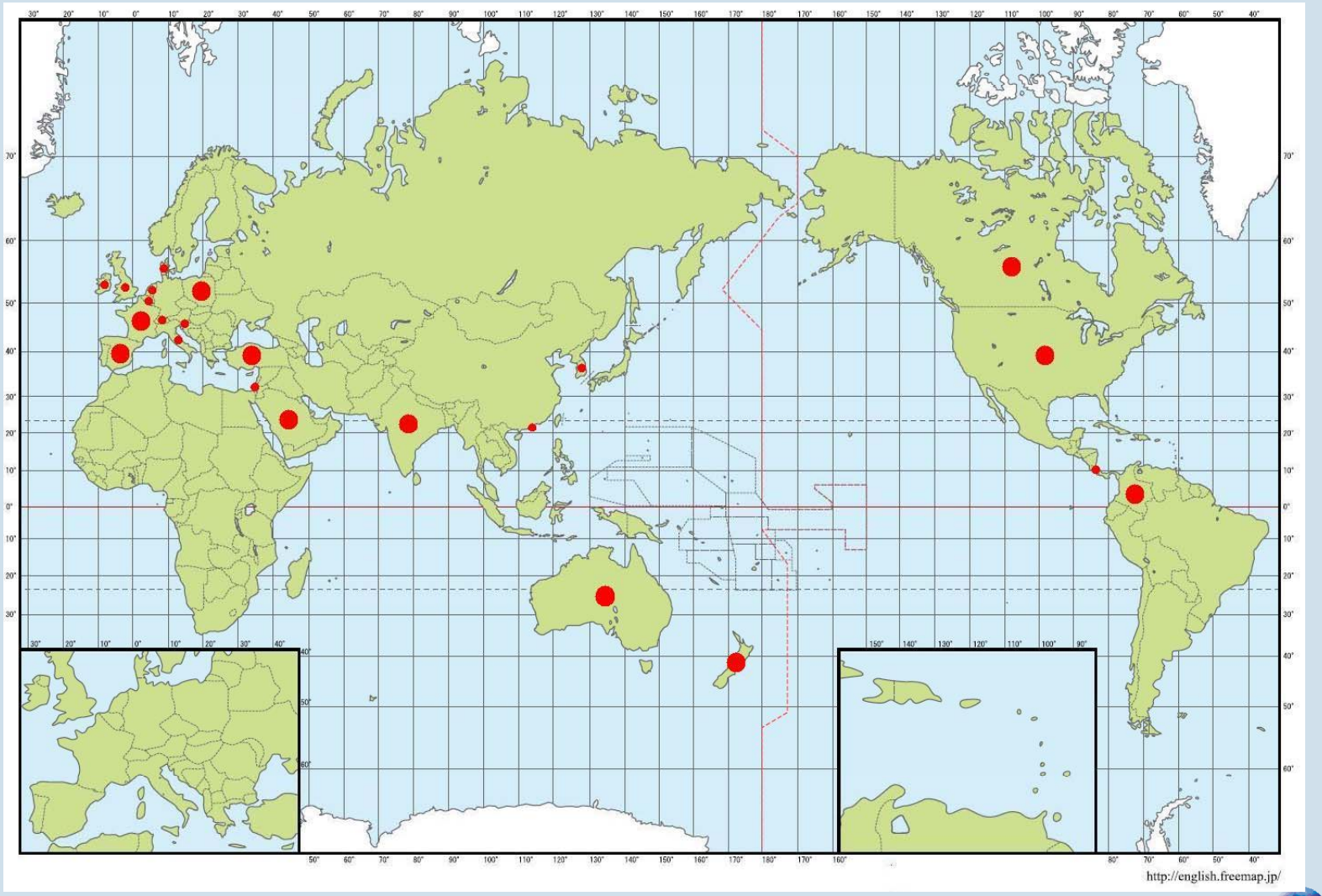
THE UNIVERSITY OF TEXAS
MD Anderson Cancer Center
Making Cancer History®

RPC

Once upon a time . . .

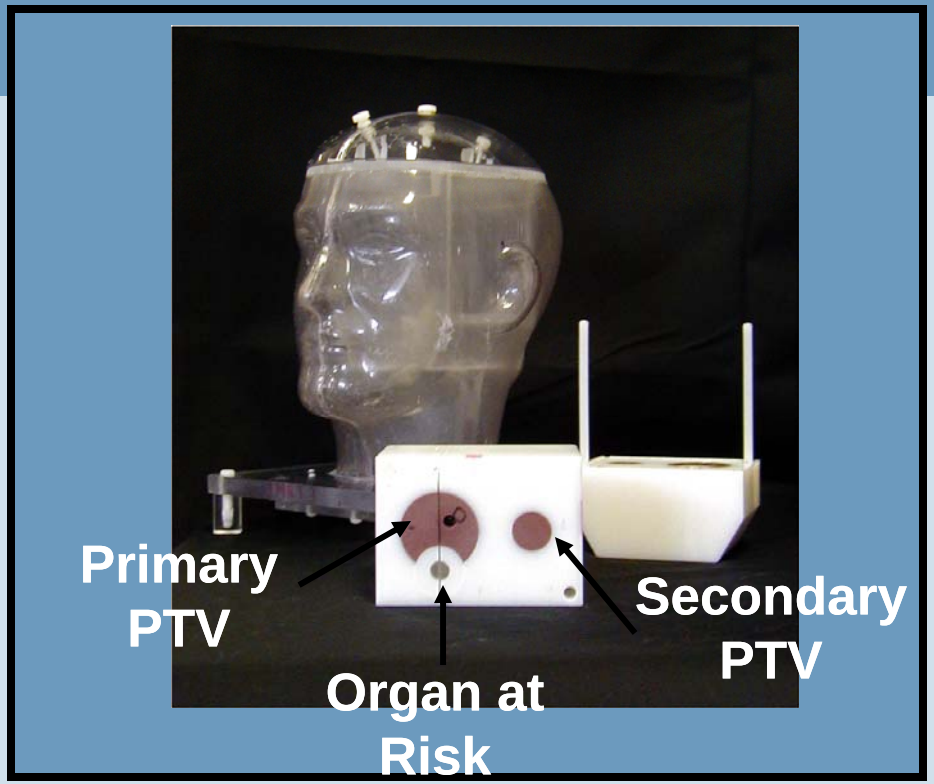
A family was made

And shipped around the world



IMRT H&N Phantom

- **Primary PTV**
  - **4 cm diameter**
  - **4 TLD**
- **Secondary PTV**
  - **2 cm diameter**
  - **2 TLD**
- **Organ at risk**
  - **1 cm diameter**
  - **2 TLD**
- **Axial and sagittal radiochromic films**

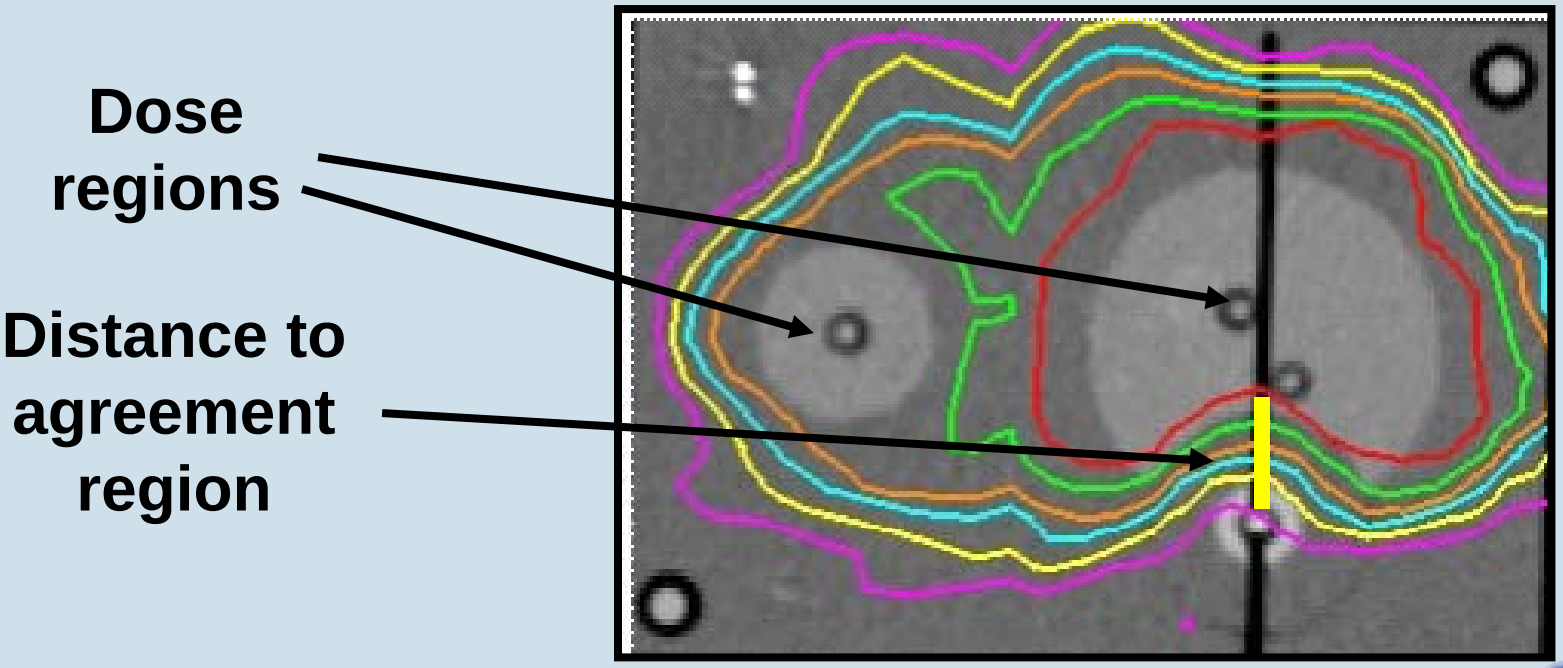


- **1º PTV treated to 6.6 Gy**
- **2º PTV treated to 5.4 Gy**
- **OAR limited to < 4.5 Gy**

Designed in collaboration with RTOG;
Molineu et al, IJROBP, October 2005

Criteria for credentialing

- **RPC/Inst dose in PTVs: 0.93-1.07**
- **distance to agreement in high gradient region near OAR: ≤ 4 mm**



IMRT H&N Phantom Results

- **1069 irradiations were analyzed**
- **866 irradiations passed the criteria**
- **203 irradiations did not pass the criteria**
- **730 institutions are represented**

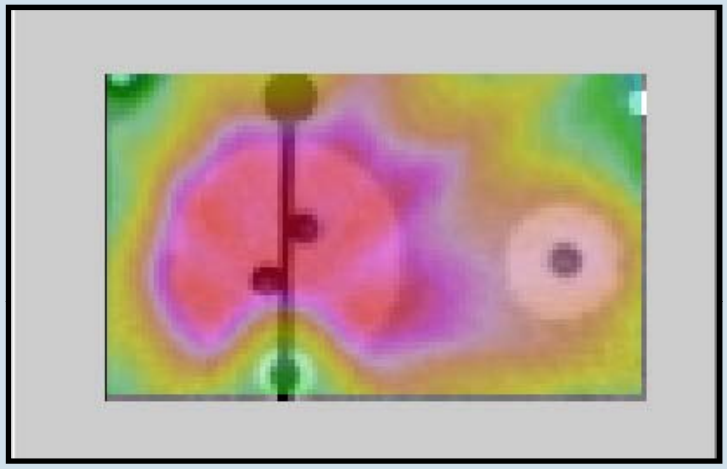
81% of irradiations passed the criteria

IMRT H&N Phantom Results cont.

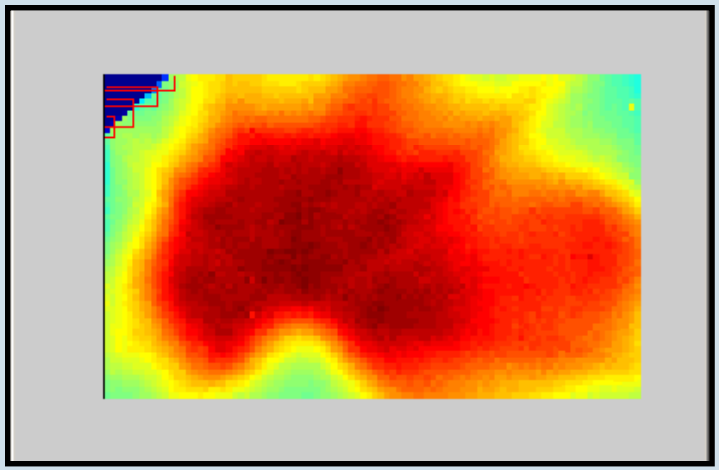
- **146 failed by absolute dose only**
- **24 failed by DTA only**
- **33 failed by both absolute dose and DTA**

	1PTV	2PTV	DTA (mm)	% Pixels pass Gamma
mean	0.98	0.98	1.7	90
std dev	0.048	0.042	1.9	14
range	0.44 – 1.23	0.40 – 1.23	0 – 17	9 - 100

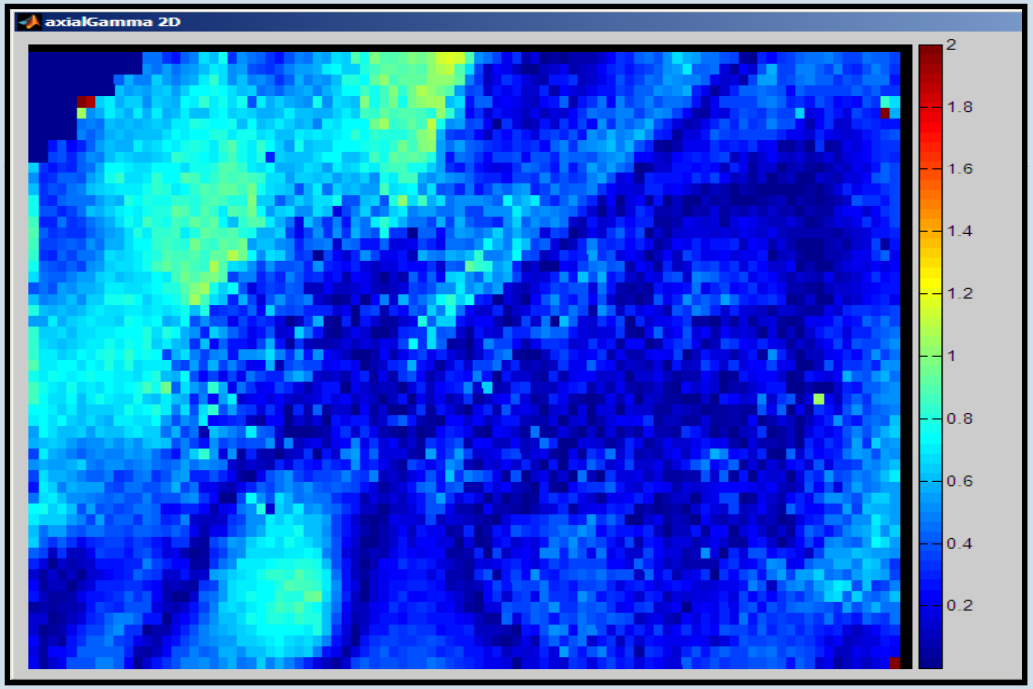
Gamma calculation



plan

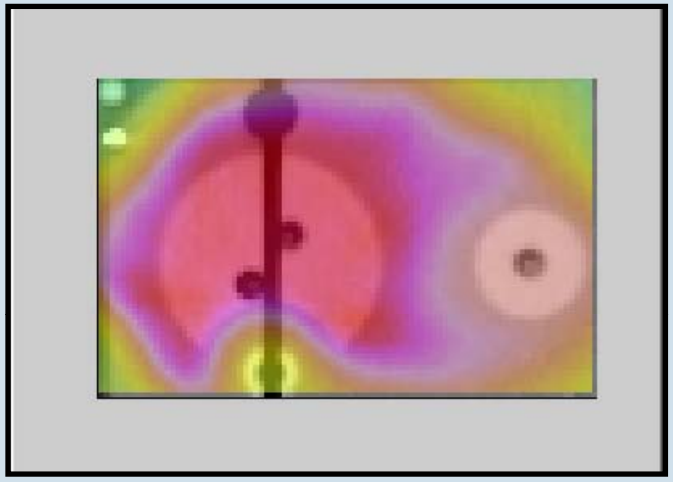


film

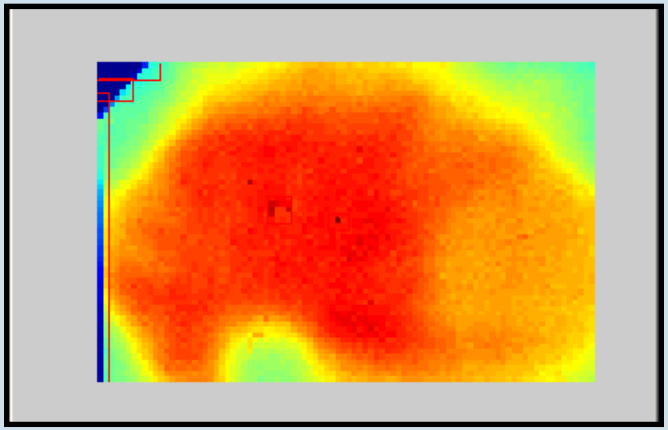


gamma

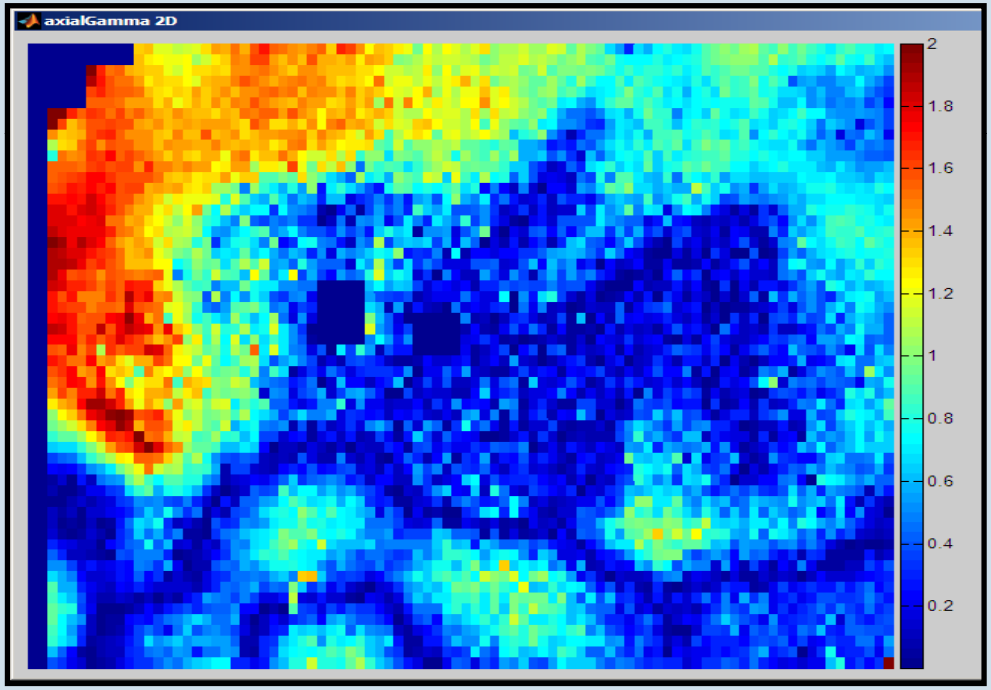
Gamma calculation



plan



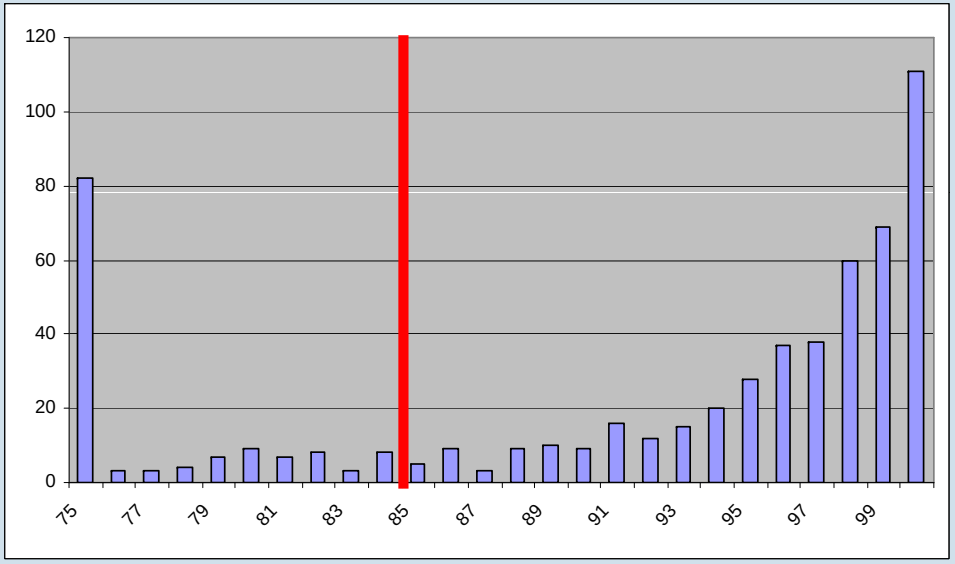
film



gamma

Gamma criteria proposal

- 85% of pixels pass 7%/4mm gamma
- Use axial and sagittal films
- replace current DTA criteria



This is expected to decrease the current pass rate to around 75%

IMRT Technique

IMRT technique	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	DTA	Dose and DTA
Dynamic MLC	88	279	23	5	5
IMAT	85	79	9	0	3
Segmental	76	613	105	17	25
Solid Attenuator	43	7	3	1	0
TomoTherapy	92	91	6	1	0
total		1069	146	24	33

Linear Accelerator Manufacturer

Linear Accelerator Manufacturer	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	DTA	Dose and DTA
Elekta	67	115	32	4	2
Siemens	69	131	31	4	6
TomoTherapy	92	91	6	1	0
Varian	84	732	77	15	25
total		1069	146	24	33

Treatment Planning System

Treatment planning system	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	DTA	Dose and DTA
Eclipse	88	353	27	8	7
Pinnacle	75	406	80	9	13
TomoTherapy	92	91	6	1	0
XiO	75	133	17	6	10
Other	78	86	16	0	3
total		1069	146	24	33

Linear Accelerator and TPS

Linac/TPS Combination	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	DTA	Dose and DTA
Elekta/Pinnacle	65	81	25	3	0
Elekta/XiO	77	22	2	1	2
Siemens/Pinnacle	66	73	21	0	4
Siemens/XiO	70	37	6	3	2
HiArt/TomoTherapy	92	91	6	1	0
Varian/Eclipse	90	337	20	7	7
Varian/Pinnacle	80	260	37	6	9
Varian/XiO	77	74	9	2	6

Tightened criteria—5%/4 mm

Treatment planning system	Pass Rate (%)
Eclipse	71
Pinnacle	55
TomoTherapy	78
XiO	53
Other	56

Failures double to 405

Conclusions

- Important QA tool
- Aids improvements to IMRT delivery
- All major linear accelerator and planning systems have ability to pass

Happily ever after . . .

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