Permanent Prostate Brachytherapy Post Procedure Evaluation

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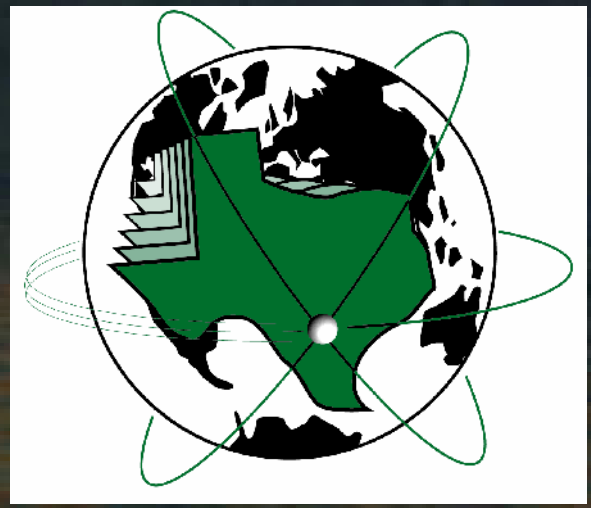
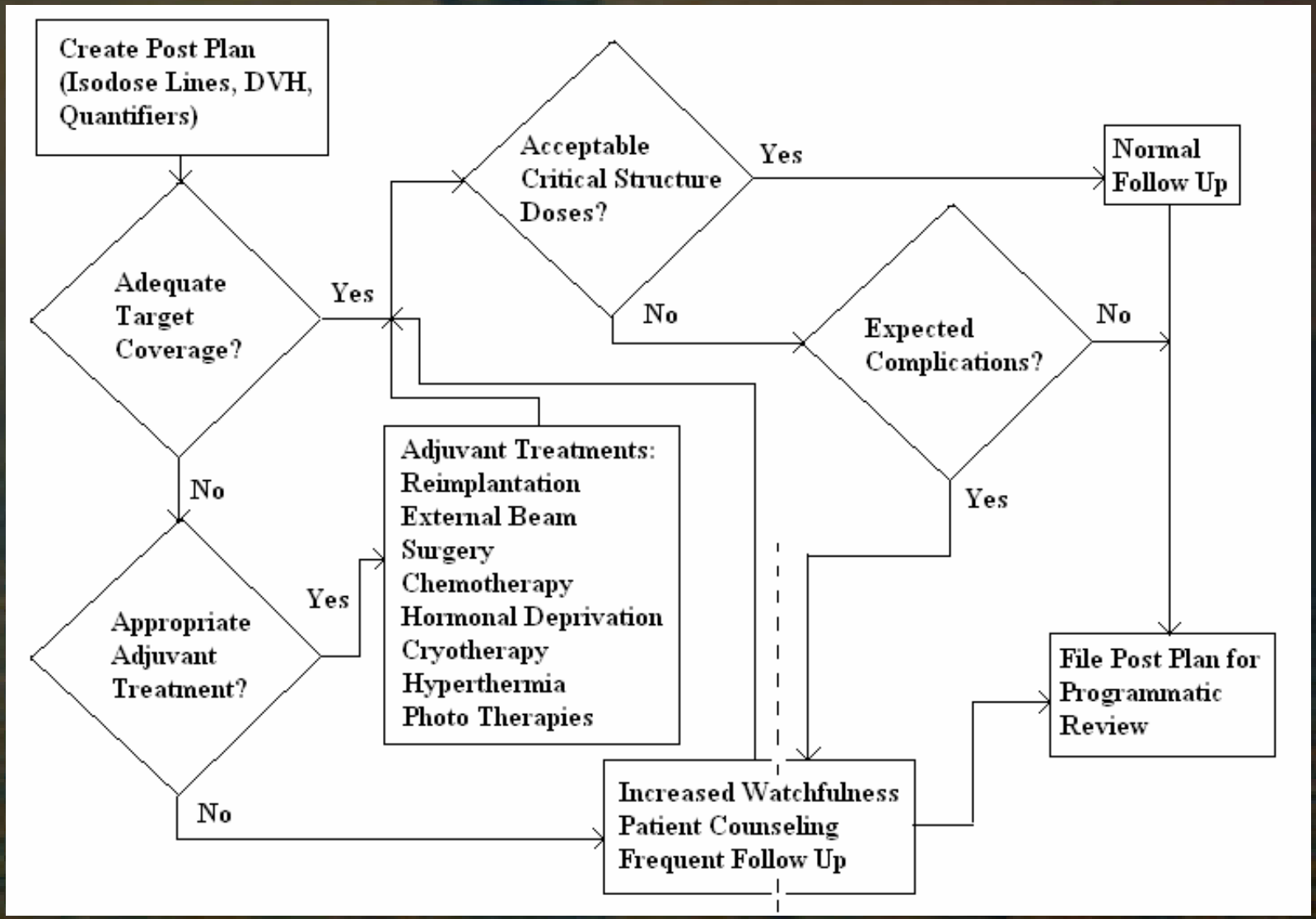


Implant Evaluation for the Patient



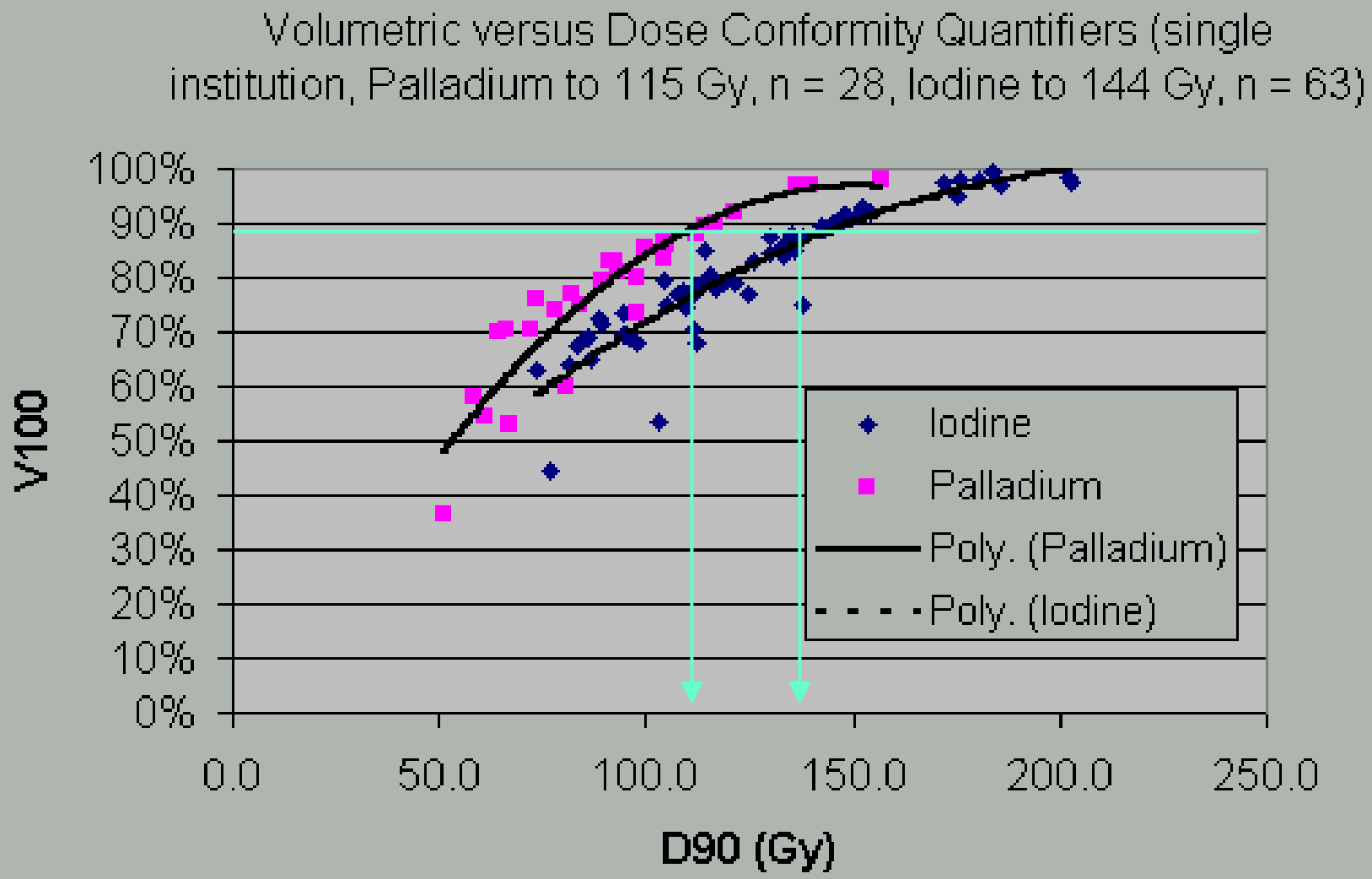
Implant Targets

- “It is a far, far better thing to have a firm anchor in nonsense than to put out on the troubled sea of thought.”

– John Kenneth Galbraith

Structure	Intent	Goal	References
Prostate Gland	**Cure**	**D_{90} for iodine monotherapy > 140 Gy** **D_{90} for palladium monotherapy > 125 Gy** **D_{90} for boosts > reference dose**	**Stock 1998** **Potters 2001**
Prostate Gland	Urethral complications	D_{90} < 180 Gy V_{150} < 60% reference dose	Stock 2002 Merrick 2002a
Membranous Urethra	Urethral complications	Dose to the membranous urethra < reference dose	Merrick 2002a
Rectum	Rectal complications	Dose to > 1 cm length of anterior mucosal wall < reference dose Max dose to anterior mucosal wall < 120% of reference dose	Merrick 1999
Rectum	Rectal complications	Annular DVH of rectum < 1.3 cm^3 to 160 Gy (iodine)	Snyder 2001
Rectum	Rectal complications	Surface area of outer rectal wall < 5 cm^2 to reference dose	Han 2001

D_{90} Compared to V_{100}



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Prostate Gland	Cure	D90 for iodine monotherapy > 140 Gy D90 for palladium monotherapy > 125 Gy D90 for boosts > reference dose	Stock 1998 Potters 2001
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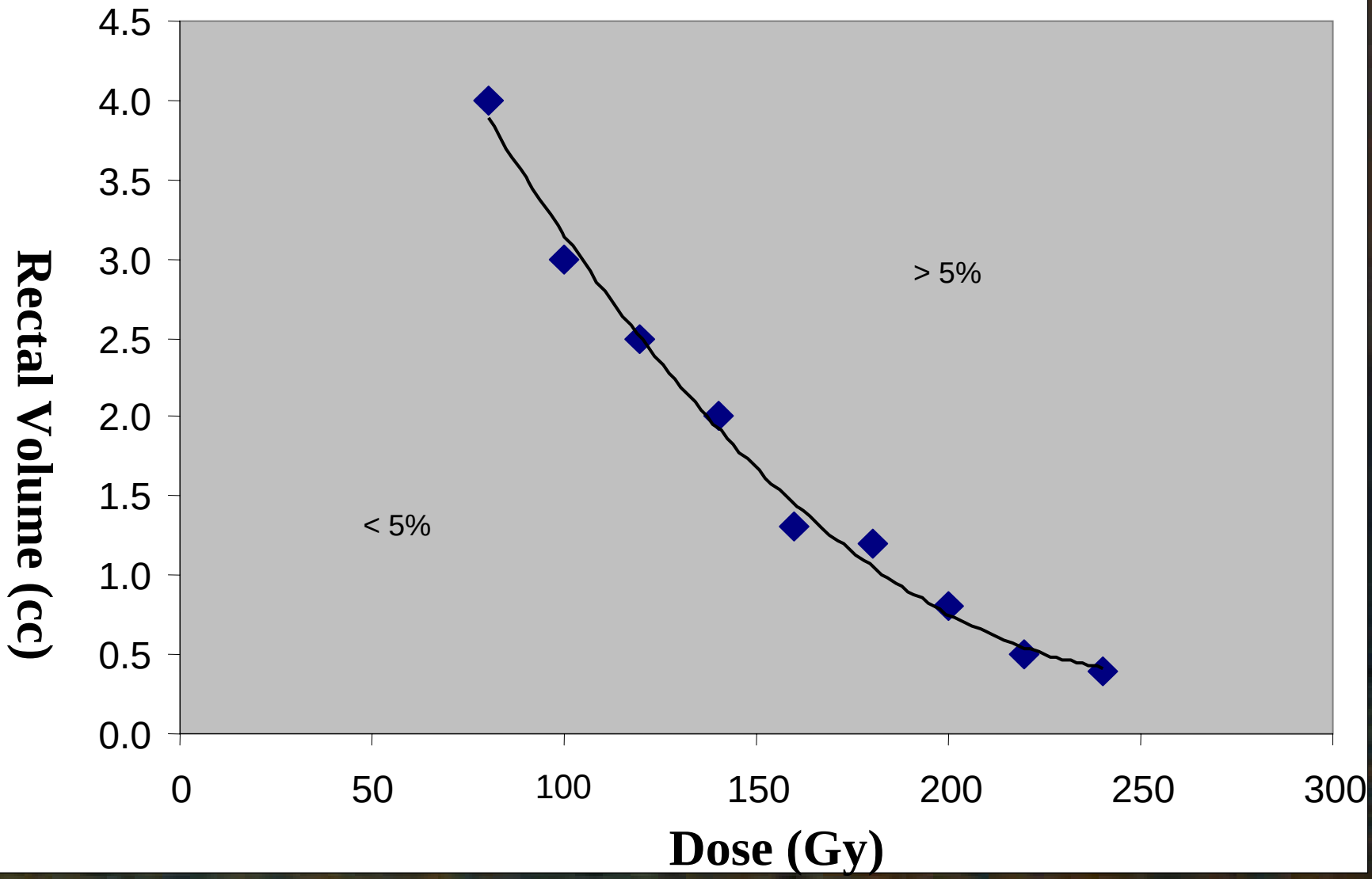
Rectal Volume cutpoint for less than 5% incidence of Grade 2 proctitis (cc)



Snyder (Stock), IJROBP 2001

Post Plan Evaluation Targets

- Isodose evaluation
- Coverage
  - D_{90} > Rx dose
  - V_{90} > 90%, V_{100} > 87%
- Urethra
  - < 150% of Rx dose, 200% maximum
- Rectum
  - < 120% of Rx dose
  - < 1.5 cc of rectum > Rx dose
- Potency
  - Stay away from the penile bulb and the membranous urethra (watch inferior dose distribution)


A Test on Post Implant Evaluation

Evaluation Exercise

- During an implant review, I come across an implant performed on Mr. Anonymous
- T2a, GSS=6, PSA = 9.4, ^{125}I monotherapy
- In terms of dosimetric coverage of the gland, is this a good implant (one for which I would not consider salvage—adjuvant—therapy)?
  - V_{100}, 90.1%
  - V_{150}, 47.3%
  - D_{90}, 146 Gy

Structure	Intent	Goal	References
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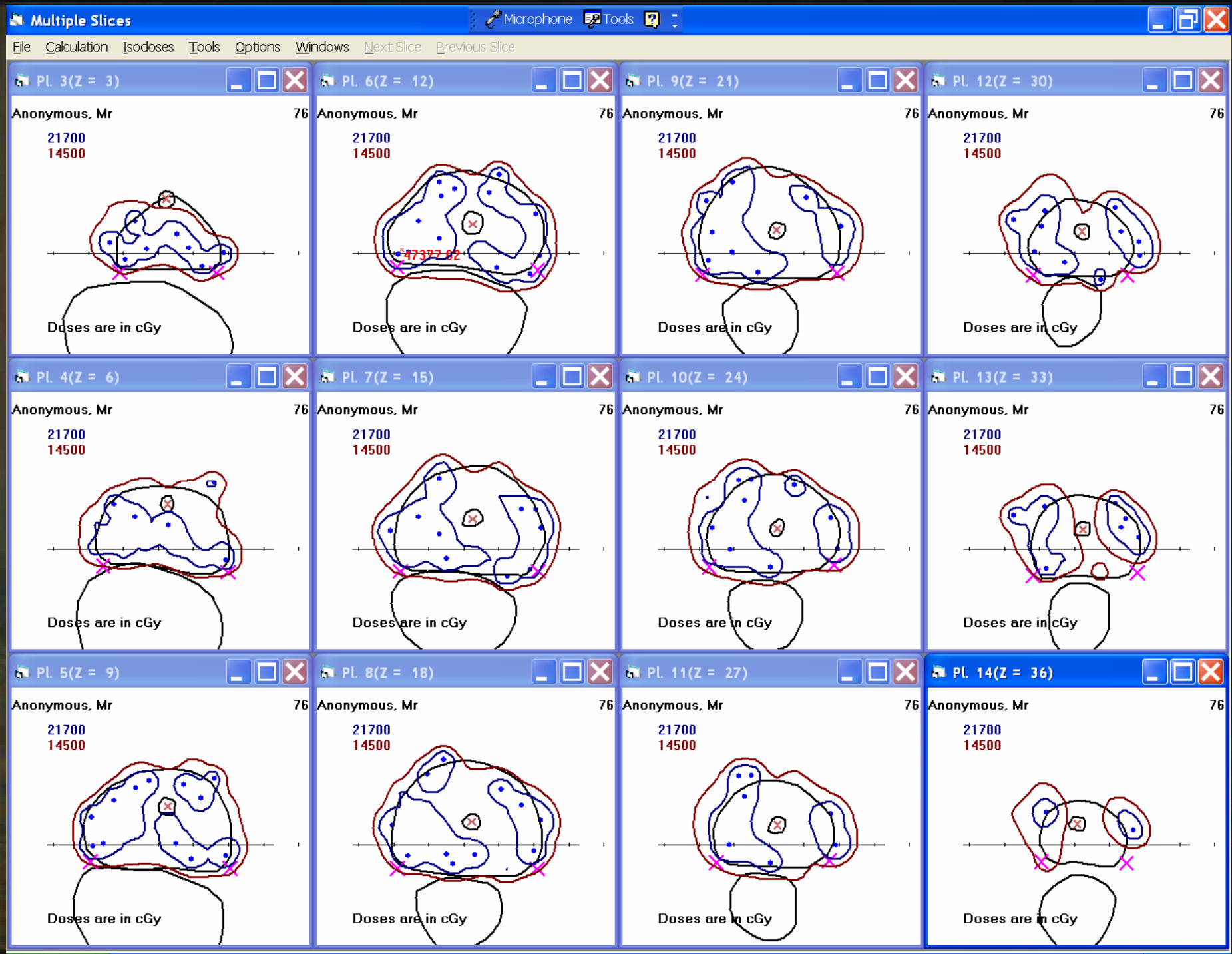
In terms of dosimetric coverage of the gland, is this a good implant?

Yes	No


Multiple Slices
Microphone
Tools
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Calculation
Isodoses
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Next Slice
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Pl. 3(Z = 3)
Pl. 6(Z = 12)
Pl. 9(Z = 21)
Pl. 12(Z = 30)
Pl. 4(Z = 6)
Pl. 7(Z = 15)
Pl. 10(Z = 24)
Pl. 13(Z = 33)
Pl. 5(Z = 9)
Pl. 8(Z = 18)
Pl. 11(Z = 27)
Pl. 14(Z = 36)
Anonymous, Mr
76
21700
14500
Doses are in cGy


Multiple Slices
Microphone
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Next Slice
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Pl. 9(Z = 21)
Pl. 12(Z = 30)
Pl. 15(Z = 39)
Pl. 18(Z = 48)
Anonymous, Mr
76
21700
14500
Doses are in cGy
7891.575

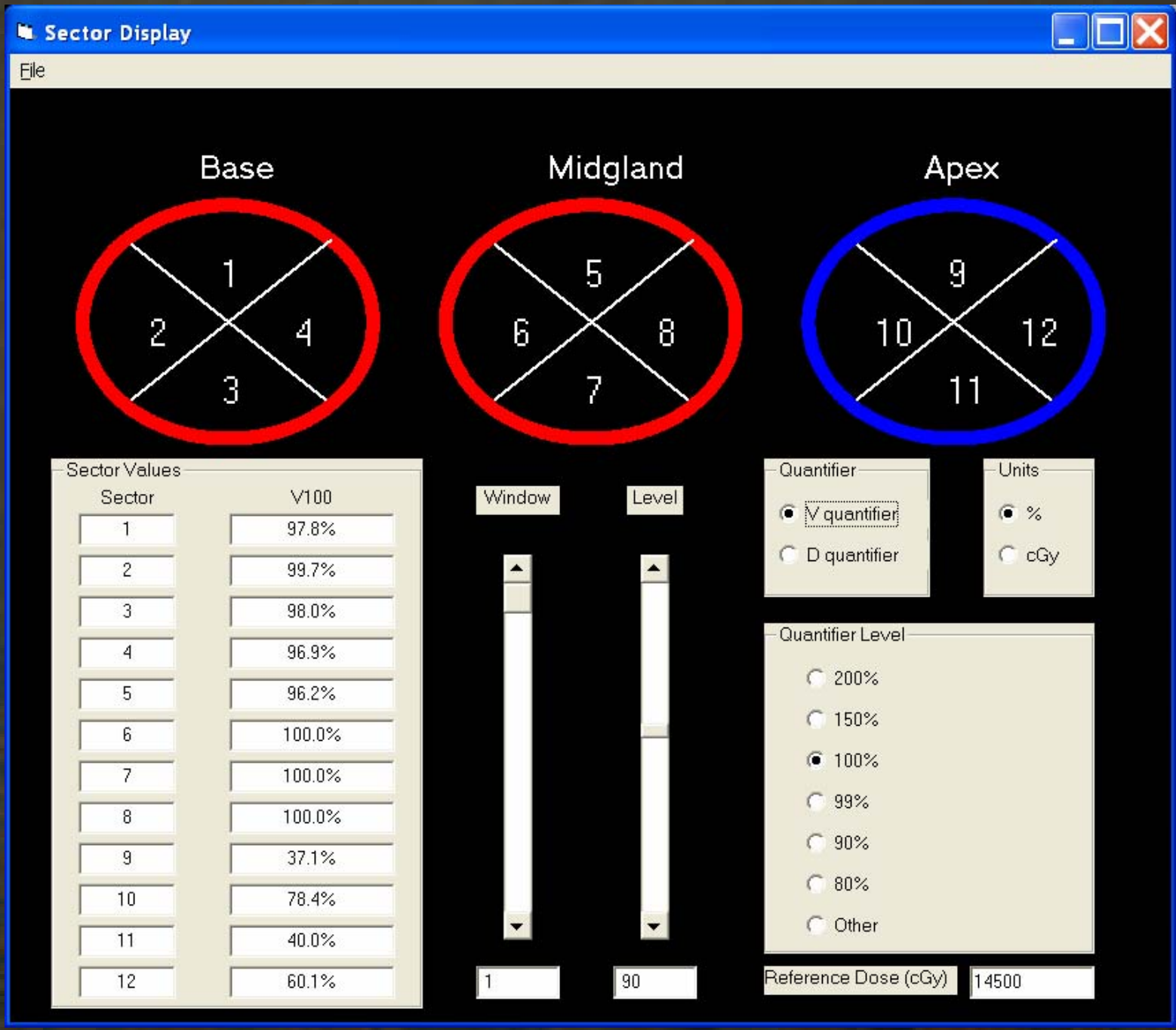
In terms of dosimetric coverage of the gland, is this a good implant?

Yes	No

More Information

- From the prescription sheet filled out by the radiation oncologist from the pathology report

Biopsy Data	Right	Left
Base		
Mid Gland		+
Apex		++


Sector Display
File
Base
Midgland
Apex
1
2
3
4
5
6
7
8
9
10
11
12
Sector Values
Sector
V100
1 97.8%
2 99.7%
3 98.0%
4 96.9%
5 96.2%
6 100.0%
7 100.0%
8 100.0%
9 37.1%
10 78.4%
11 40.0%
12 60.1%
Window
Level
1
90
Quantifier
V quantifier
D quantifier
Units
%
cGy
Quantifier Level
200%
150%
100%
99%
90%
80%
Other
Reference Dose (cGy)
14500

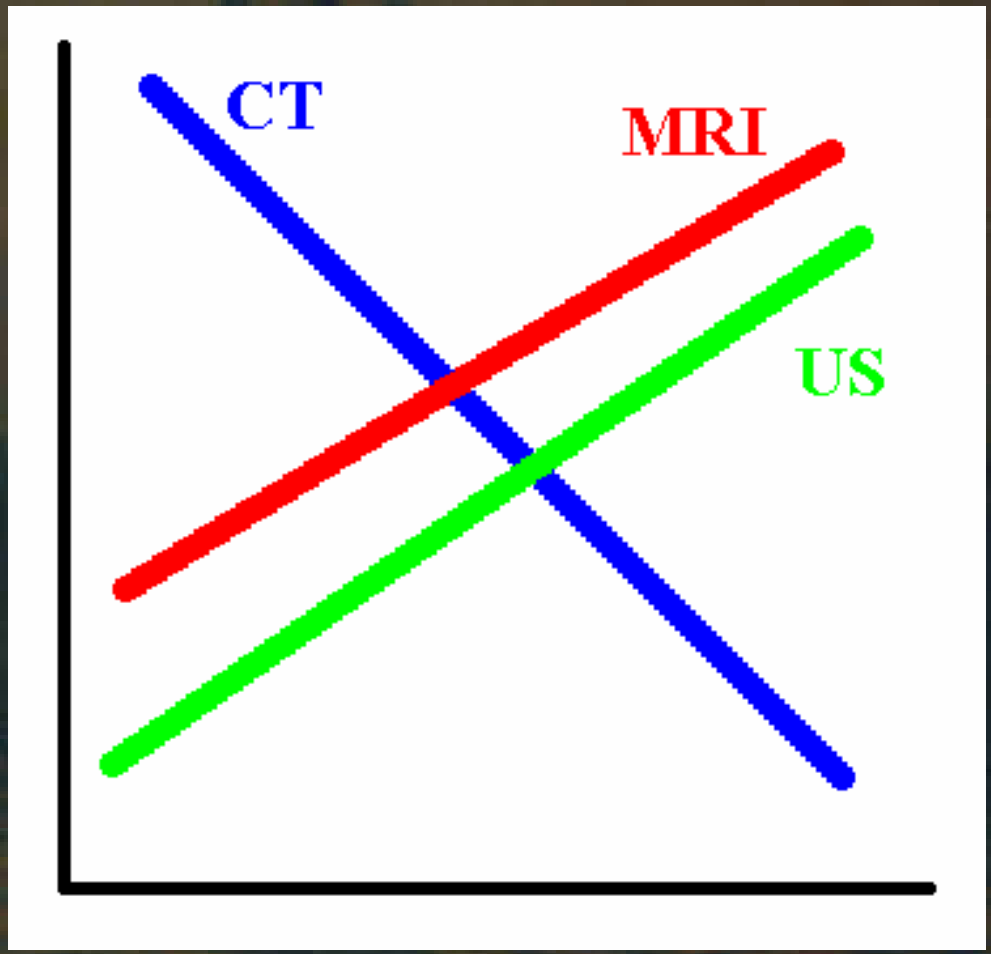
In terms of dosimetric coverage of the gland, is this a good implant?

Yes	No

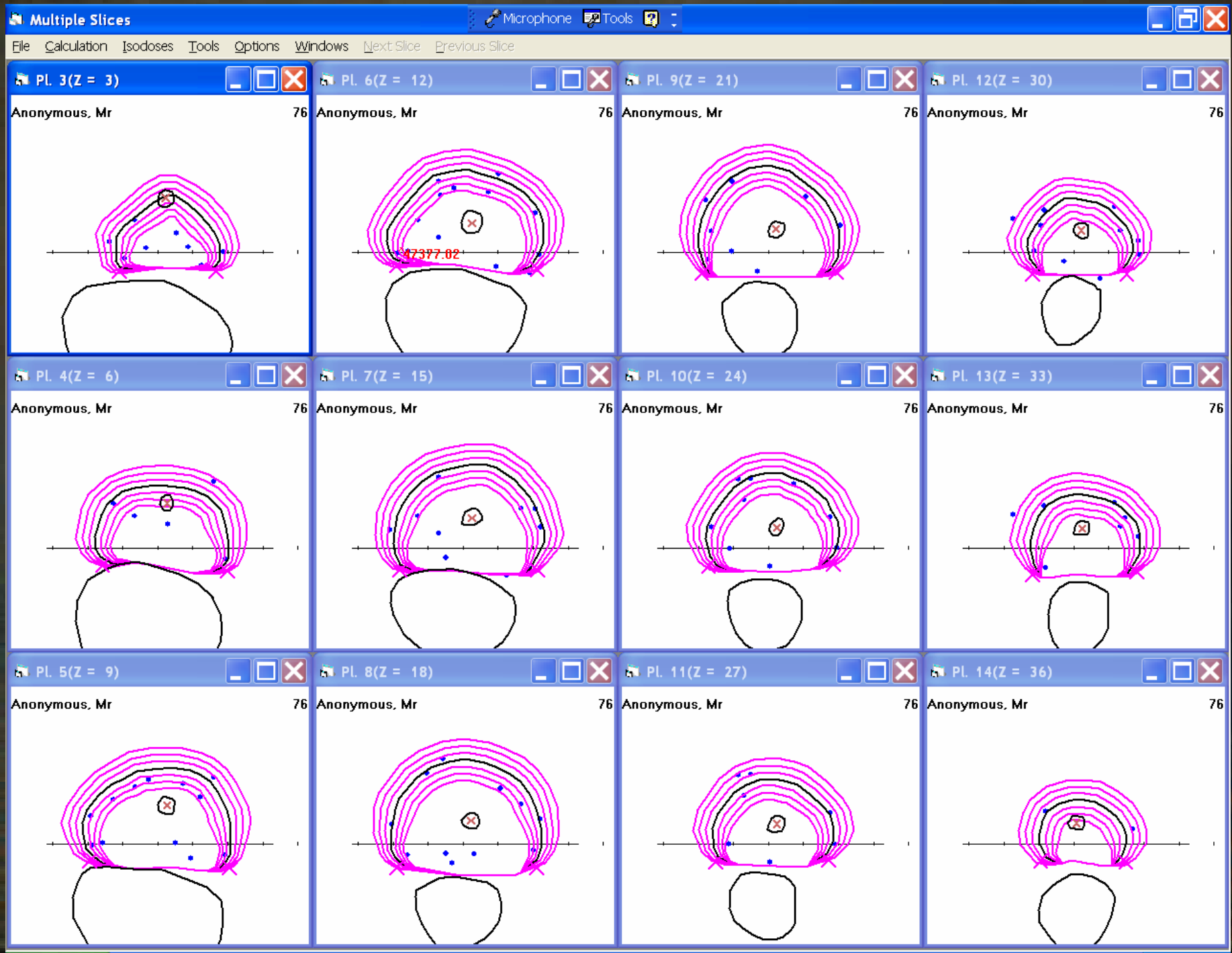
A little more information

- Preimplant Ultrasound Volume, 23.4 cc
- Postimplant CT Volume, 30.5 cc
- Volumetric change: +30%
- Base to apex dimension:
  - Preimplant: 3.5 cm
  - Postimplant: 4.2 cm

Post operative imaging



CT based dosimetry: Have we built our house upon the sand?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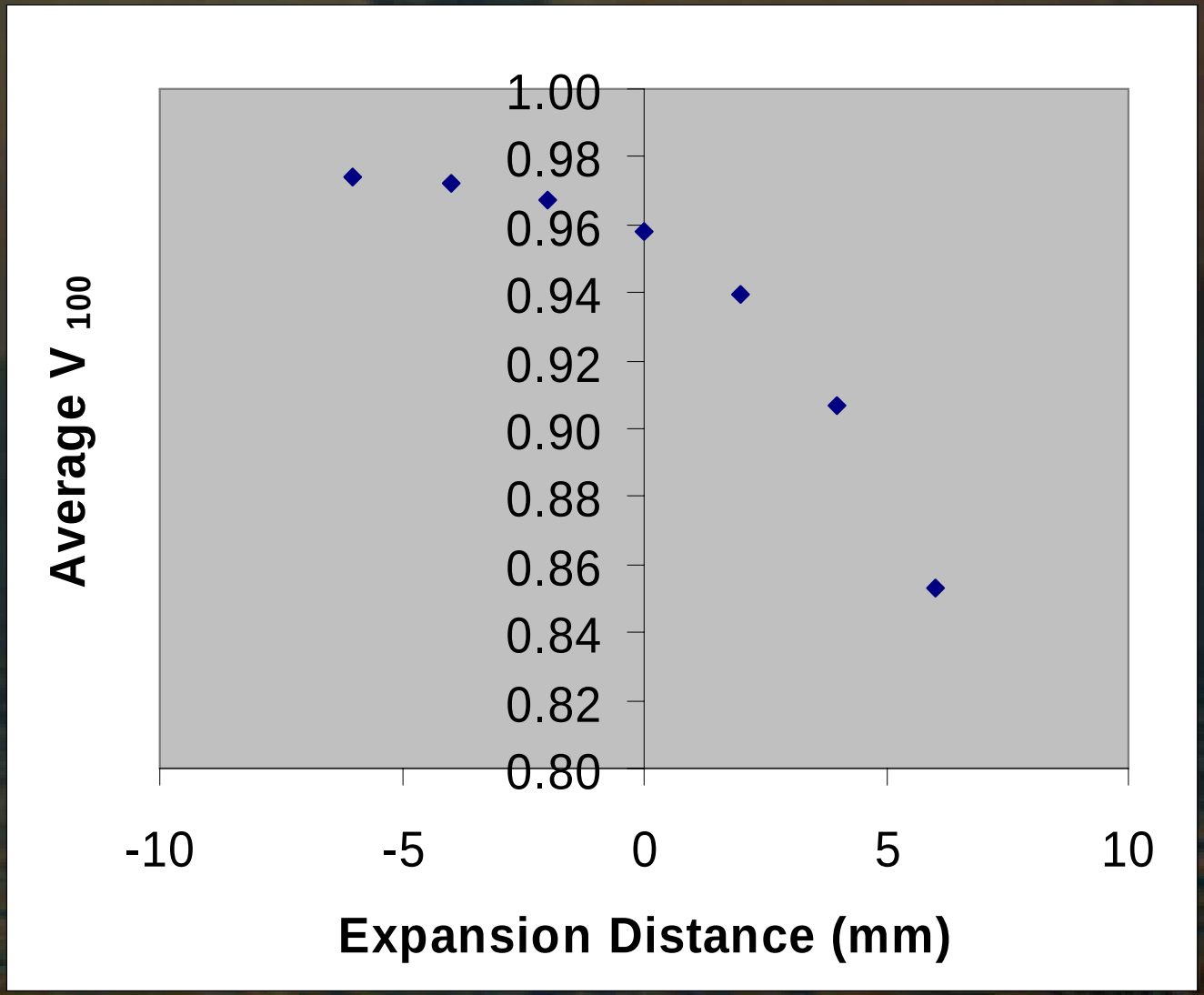
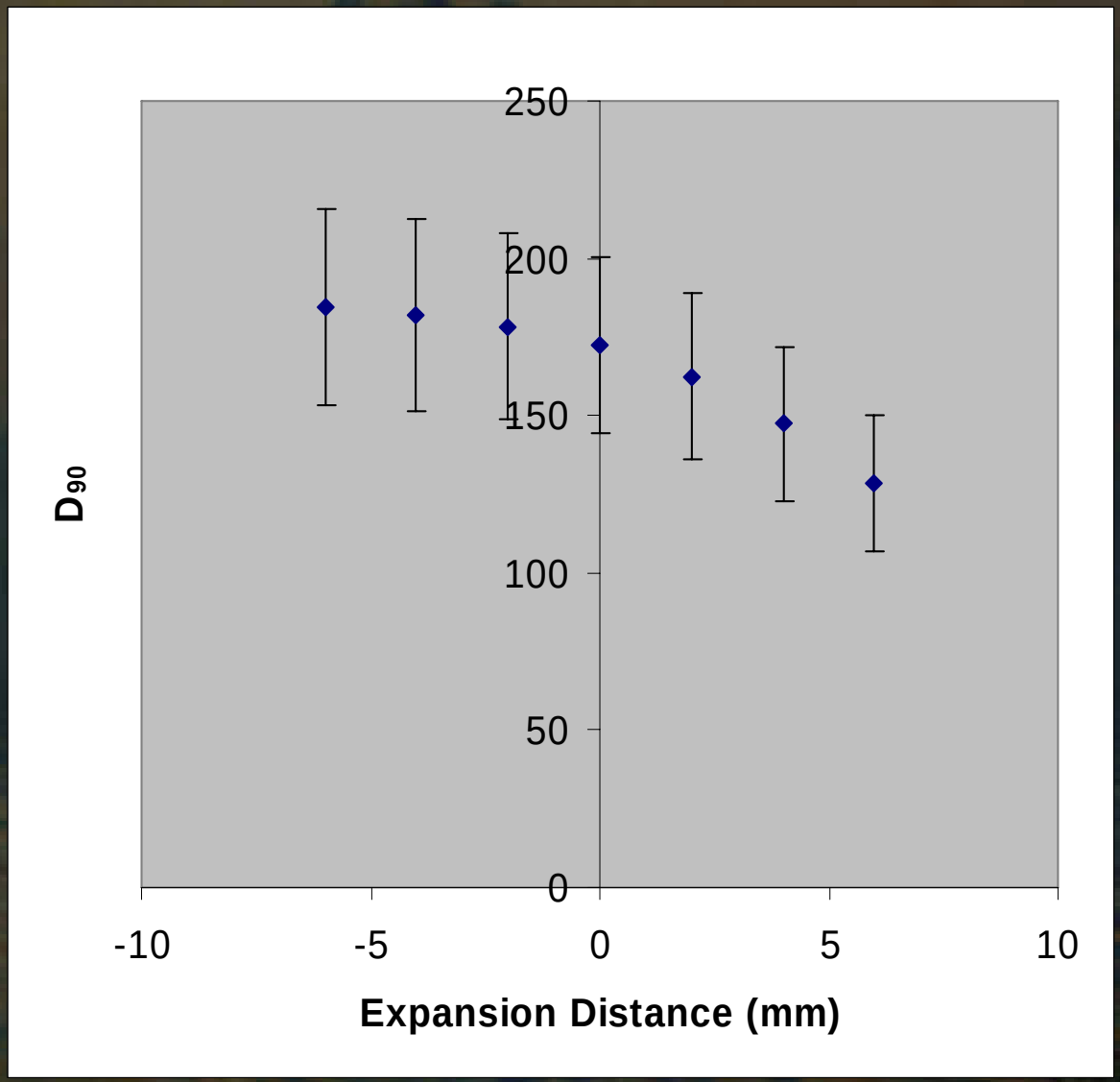
Pl. 10(Z = 24)
Pl. 13(Z = 33)
Pl. 5(Z = 9)
Pl. 8(Z = 18)
Pl. 11(Z = 27)
Pl. 14(Z = 36)
Anonymous, Mr
76
47377.02

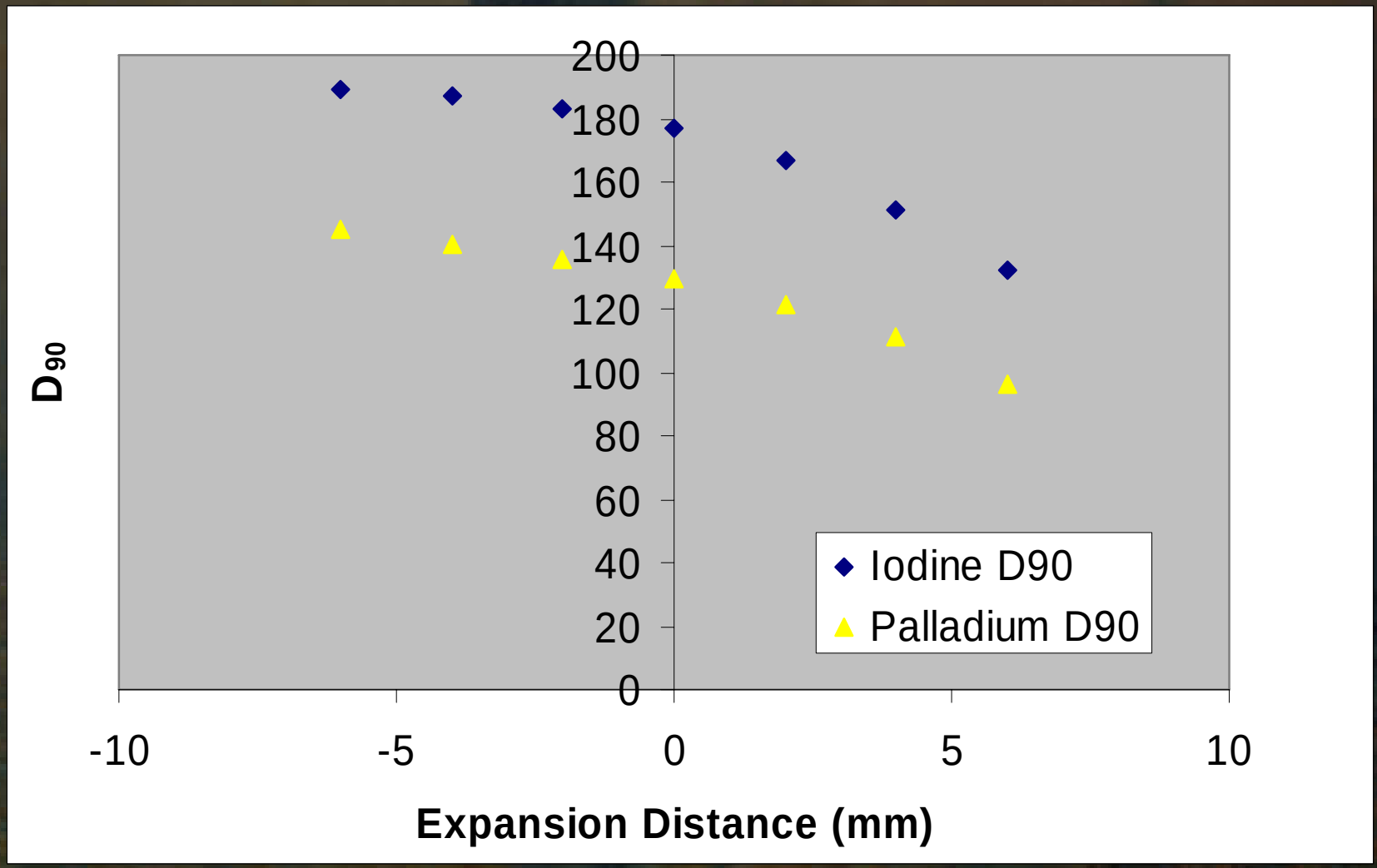
Expansion Effects on V_{100}



Expansion Effects on D_{90}



Expansion Effects on Iodine and Palladium Implants



DVH/DSH Values

File Display First Page Next Page Previous Page Options

Dose Volume/Surface Histogram Statistics

Name: Anonymous, Mr
Prescription Dose: 14500 cGy

Expansion Type: Slice-by-slice Expansion, except posterior
Expansion Distances (mm): -6, -4, -2, 0, 2, 4, 6

Expansion(mm)	Prostate Volumes(cc)
-6	17.90 cc
-4	21.49 cc
-2	25.79 cc
0	30.32 cc
2	35.70 cc
4	41.88 cc
6	48.47 cc

Volume (V) quantifier

Dist(mm)	V70	V80	V90	V99	V100	V150	V200
-6	97.9%	96.0%	94.4%	91.9%	91.6%	42.2%	10.1%
-4	97.9%	95.9%	94.2%	91.6%	91.3%	44.5%	11.6%
-2	98.0%	95.9%	93.8%	91.3%	91.0%	46.6%	13.6%
0	98.0%	95.9%	93.5%	90.5%	90.1%	47.3%	14.8%
2	97.9%	95.6%	92.6%	88.9%	88.5%	46.5%	14.6%
4	97.5%	94.3%	89.9%	85.2%	84.7%	42.6%	13.1%
6	95.5%	90.2%	84.3%	79.1%	78.6%	37.7%	11.5%
Average	97.5%	94.8%	91.8%	88.4%	88.0%	43.9%	12.8%
Std Dev	0.9%	2.1%	3.6%	4.7%	4.8%	3.4%	1.7%

Dose (D) quantifier (Gy)

Dist(mm)	D70	D80	D90	D99
-6	184	173	153	92
-4	185	172	152	93
-2	185	172	150	94
0	184	171	146	93
2	181	167	140	93
4	175	157	131	91
6	164	142	118	84
Average	180	165	142	91
Std Dev	08	11	13	03

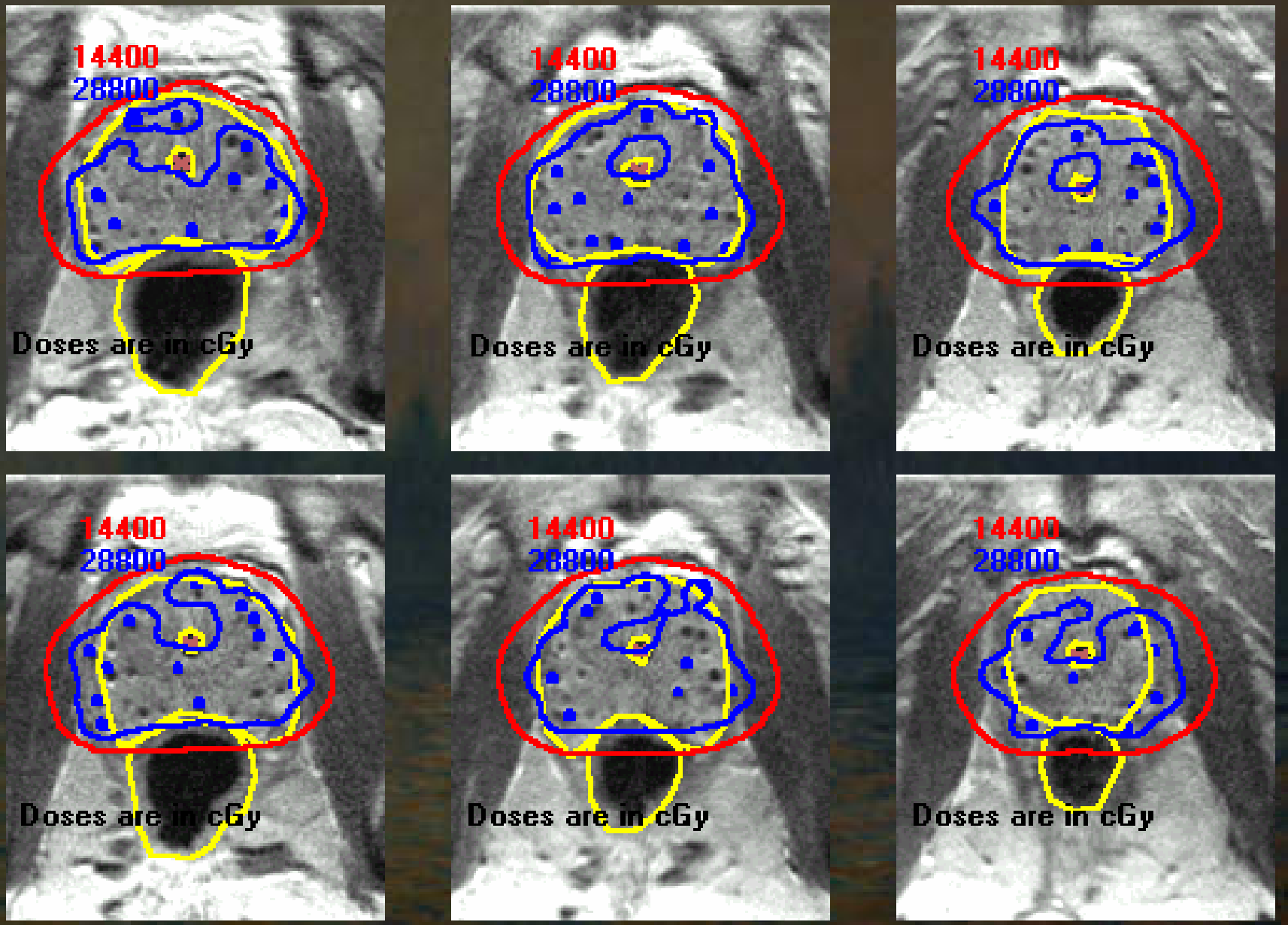
$78.6\% < V_{100} < 91.6\%$ (88.0%)

$118\ \text{Gy} < D_{90} < 153\ \text{Gy}$ (142 Gy)

In terms of dosimetric coverage of the gland, is this a good implant?

Yes	No

Coregistration Results

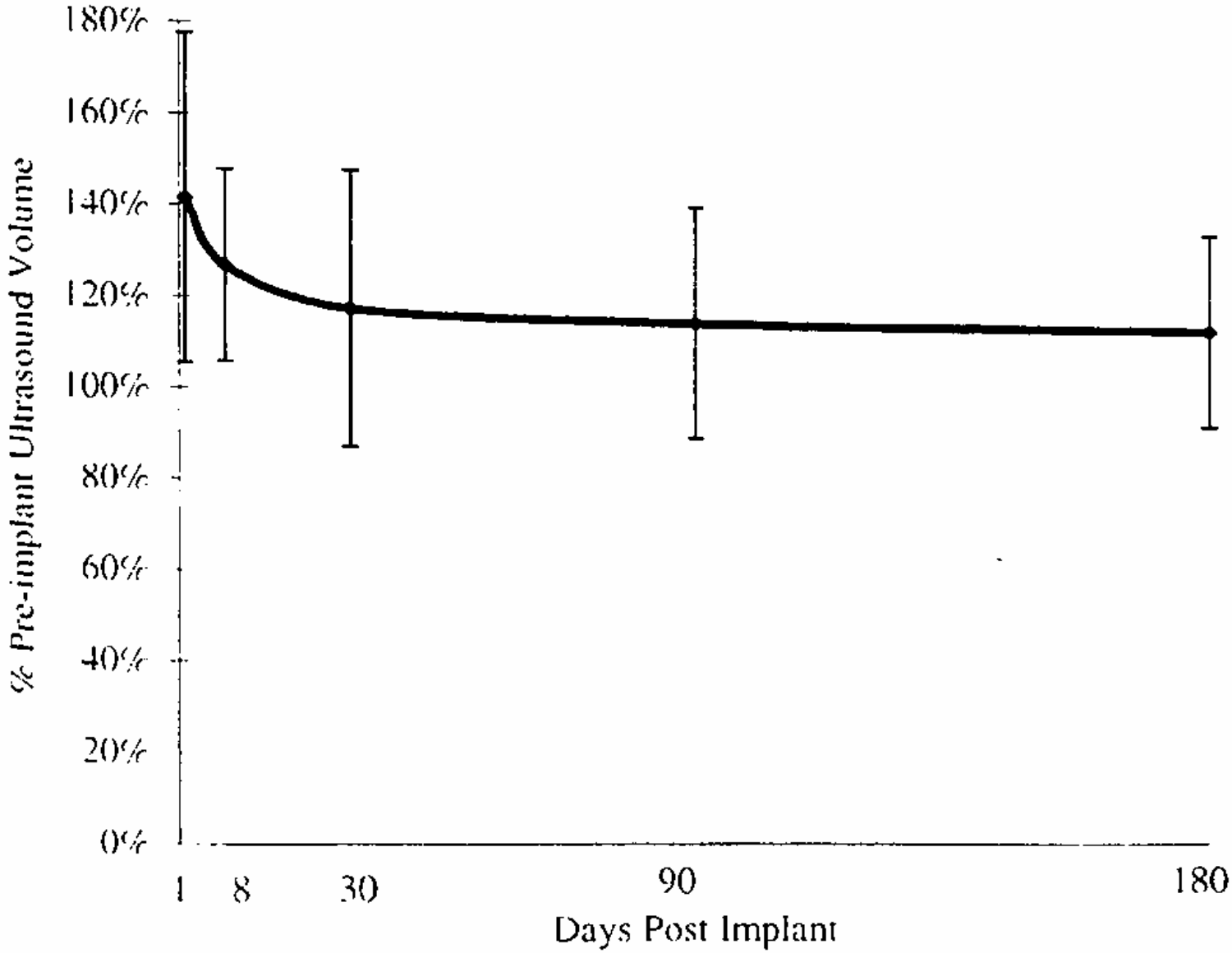


One last bit of information

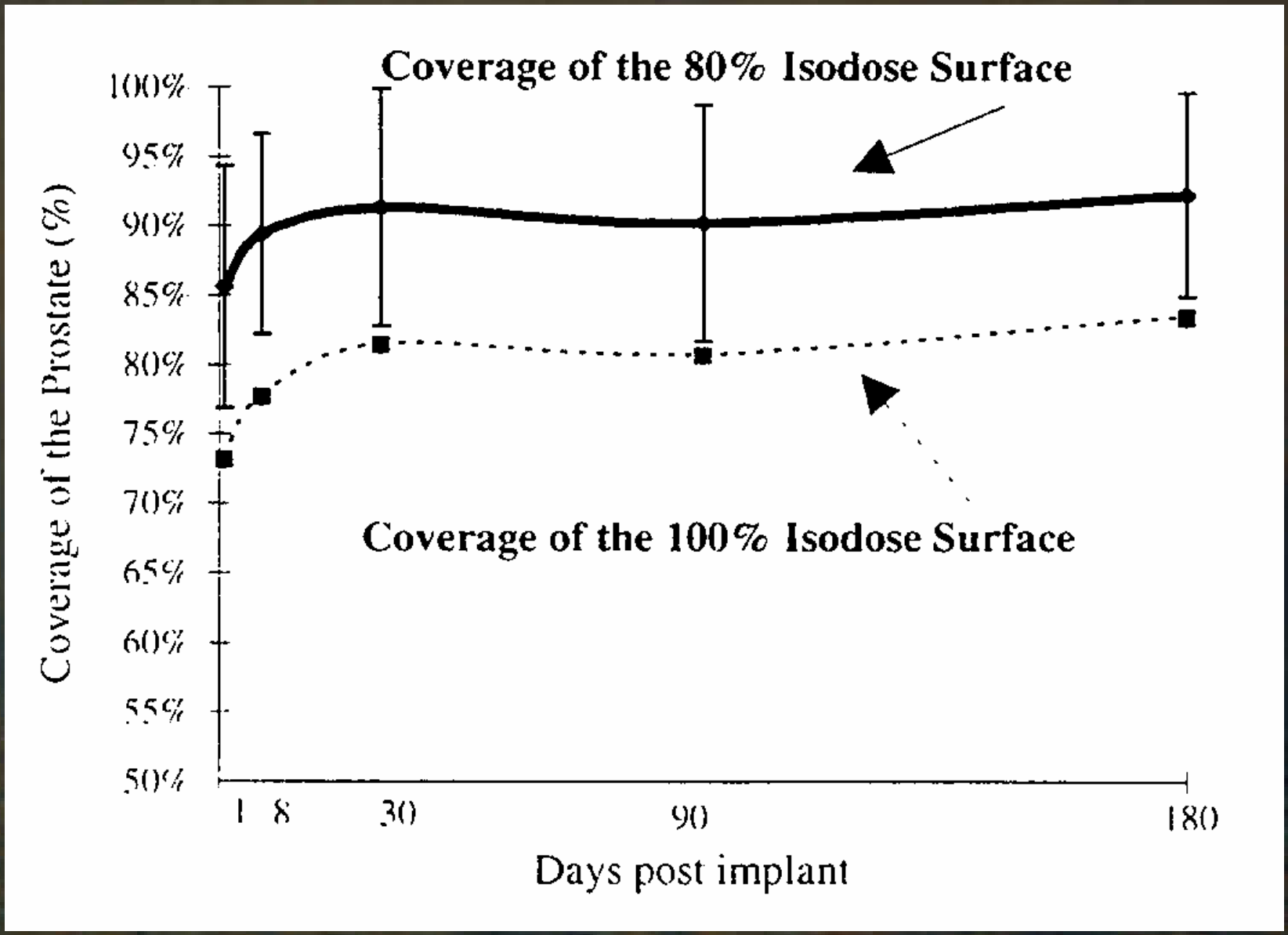
- The CT and MRI scan were performed on the day of the implant (Day 0 dosimetry)

In terms of dosimetric coverage of the gland, is this a good implant?

Yes	No

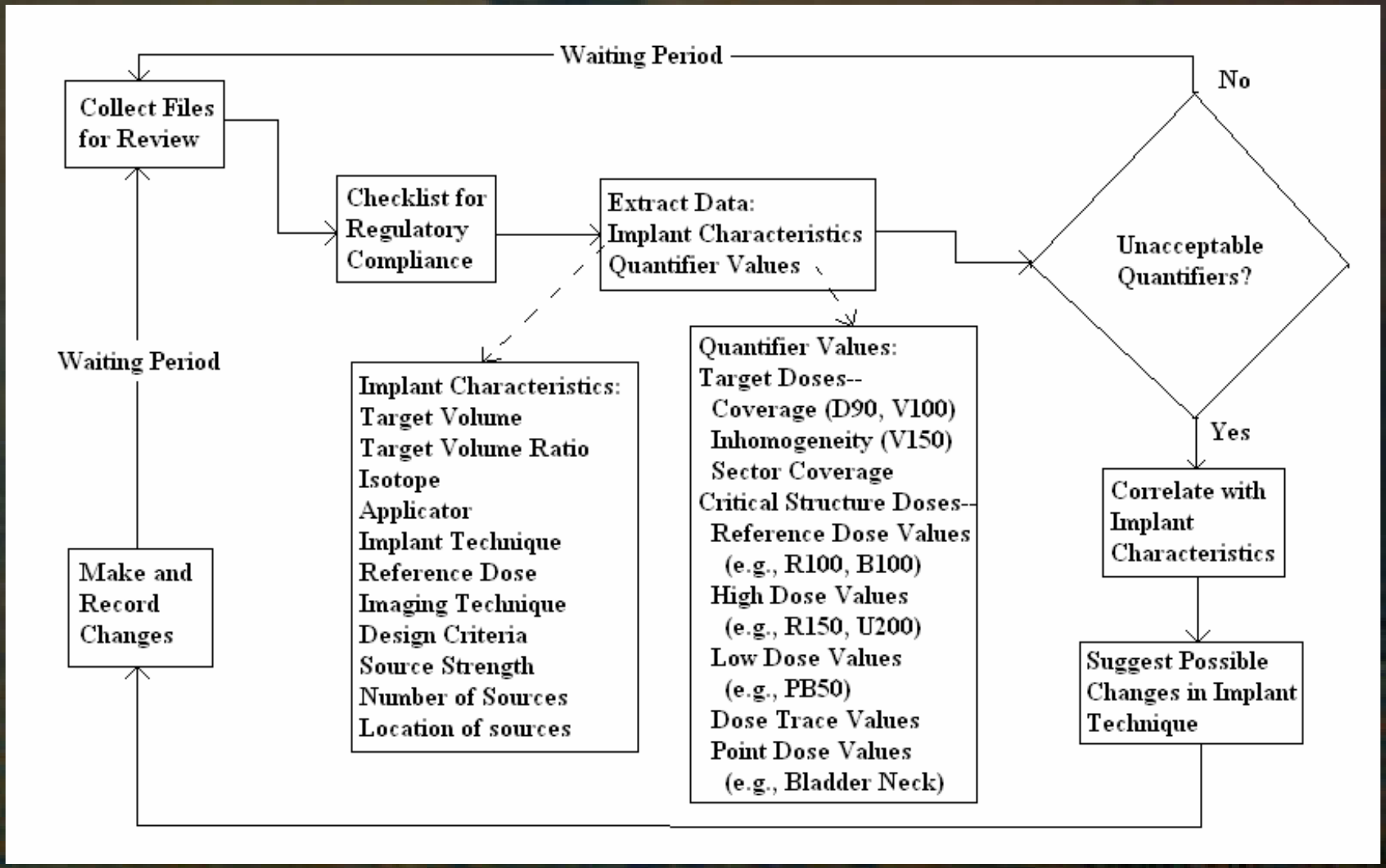


Prestidge, et al., IJROBP **40**(5): 1111-5 (1998)



Prestidge, et al., IJROBP **40**(5): 1111-5 (1998)

Implant Evaluation for the Program




Story Title: Serendipity
Scene: The Big Apple
The Year: 1995

Story #1, The Big Apple

- Wicked step mother
- Princess
- Knights in shining armor
- Wizard
- Happily-ever-after ending

Two institutions in New York performing post implant dosimetry

MSKCC (WSM)

Mt. Sinai (Princess)

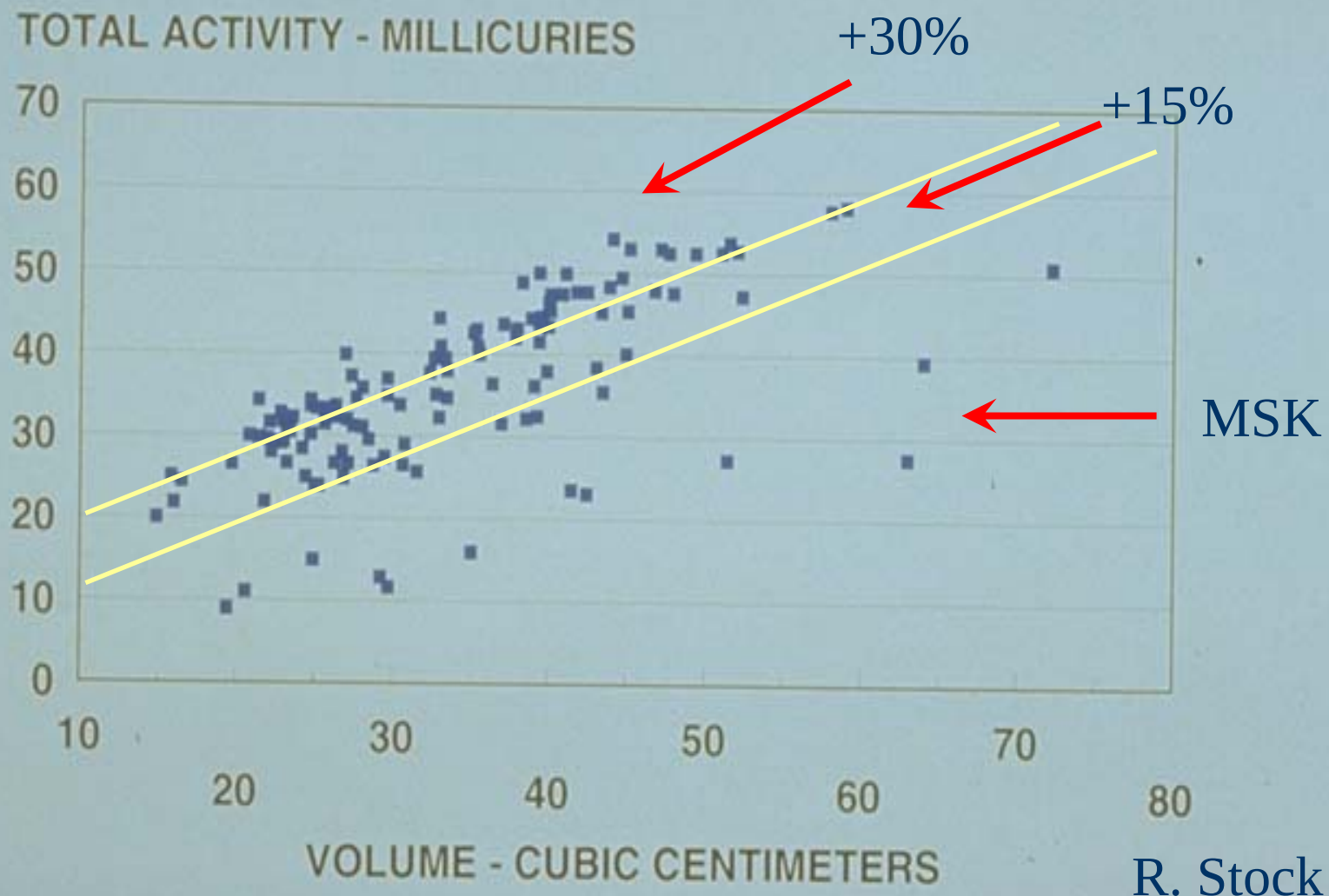
Scene

- 1995 (Seattle—Great Western Horde—raises the prostate brachytherapy bar)
  - Implant quality
  - Clinical outcomes
- MSK (WSM) does prostate brachytherapy and has since the early 70s
- Mt. Sinai marches to the sound of the guns
  - Richard Stock (KSA) and Nelson Stone (Frog Prince)
  - Kieth DeWyngaert (Wizard)

Action

- Mt. Sinai implant technique
  - Nomogram (WSM)
  - Implant rules (KSA, Wizard)
  - Patients (Frog Prince)
- CT-based post implant dosimetry (KSA, Wizard)
- Implant review, tough questions (KSA)

I - 125 PROSTATE IMPLANTS: ACTIVITIES PER VOLUME



R. Stock

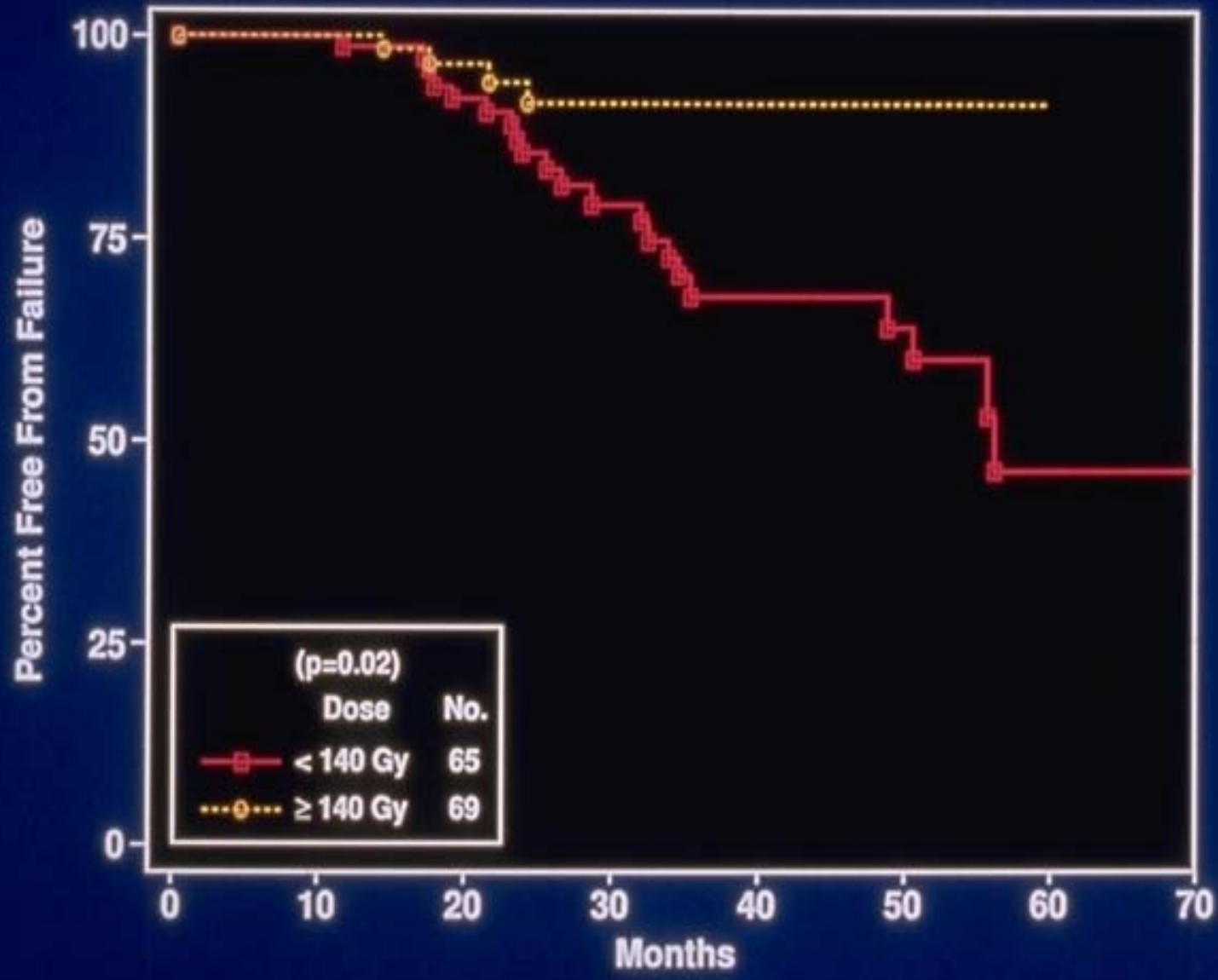
A Dose Response Study for I-125 Implants

- **134 patients**
- **T1-T2 prostate cancer**
- **Follow-up 12-74 months (median 32)**
- **PSA 1.9-180 ng/ml (median 7.8)**
- **Gleason score 2-6**
- **CT based dosimetry**

Stock RG, Stone NN, Tabert A, Iannuzzi C, DeWyngaert JK: A dose-response study for I-125 prostate implants. Int J Radiat Oncol Biol Phys 41: 101-108, 1998.

R. Stock

Effect of Dose on Biochemical Failure



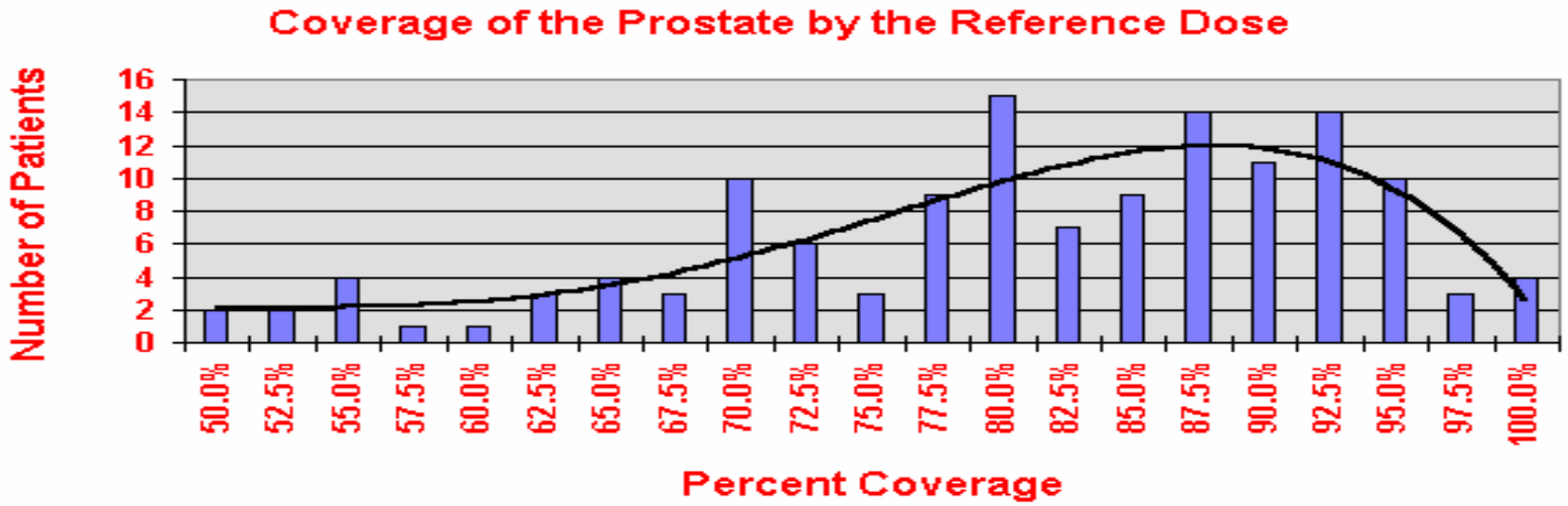
R. Stock

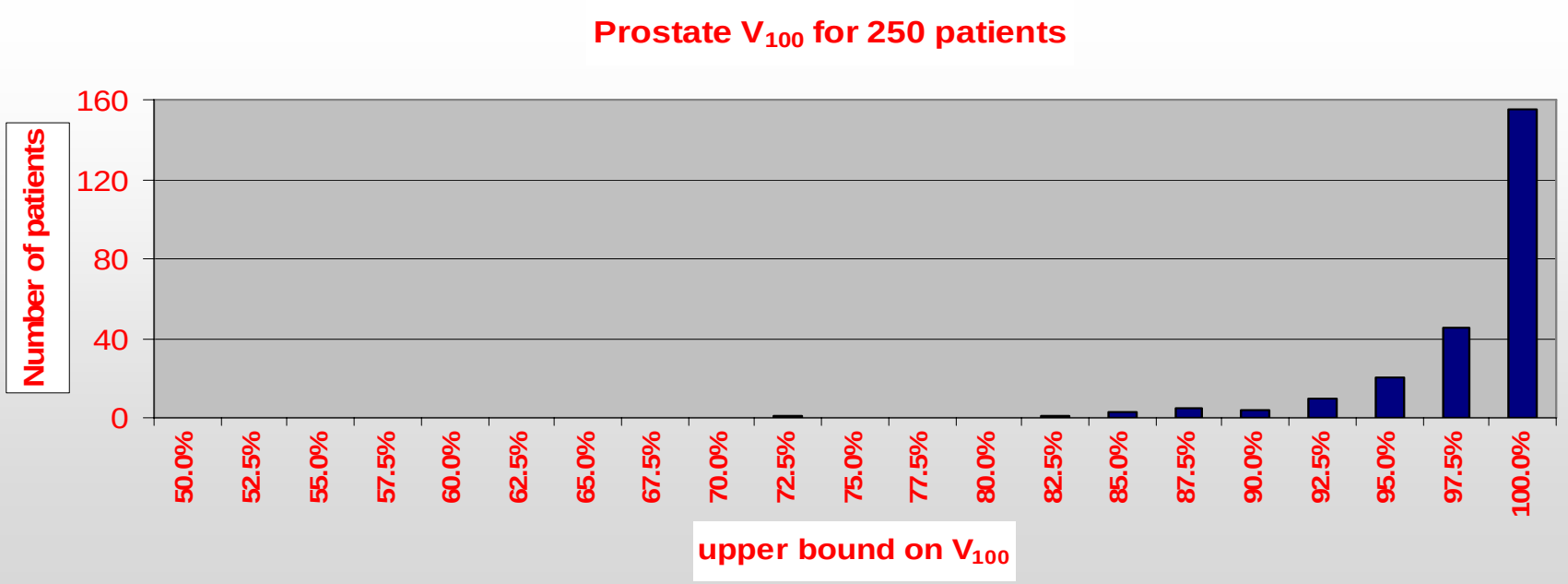
Story #2, Contemplation
Scene: San Antonio, Texas
The Year: 2002
(Subtitle: Loose Seed Needles vs. Mick Applicator using Sector Analysis)

Bice, Med Phys, 2001

Story #3, Motivation

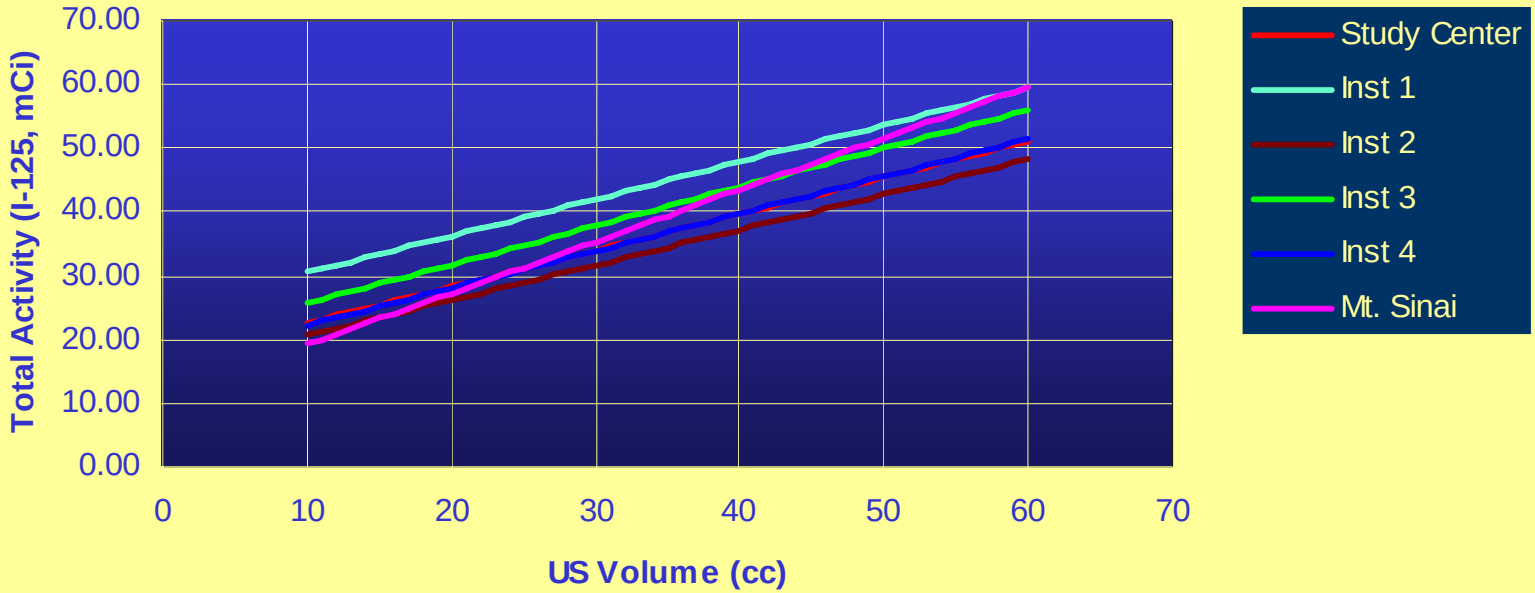
Improvement of coverage






Don't forget non-volume based quantifiers

Total Activity (mCi) by US Prostate Volume (cc)



Bice, et al., IJROBP, 1998

Post Implant Planning and Evaluation

- Review is required by law (some places)
- Standard of care
- It gives your physics staff something to do
- You cannot improve without it
- You get paid for it

Concluding Thoughts

- You have to perform the regulatory requirements
- In order to achieve and maintain a high level of implant quality
  - Post plan
  - Evaluate
    - Each patient
    - Patient groups
  - Set goals (change and re-evaluate)