ATC Meeting
March 28, 2008

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ATIC Hypotheses

1. Advanced radiation therapy technologies will improve local tumor control and survival rates.
2. Advanced radiation therapy technologies will reduce normal organ toxicity
3. Advanced radiation therapy technologies allow investigation of novel fractionation schedules
4. Image-Guided radiation therapy (IGRT) will improve the accuracy of treatment delivery and provide patient specific dose volume data that is directly correlated with patient outcome
5. Diagnostic imaging modalities such as positron emission tomography (PET) and new magnetic resonance imaging methods will improve patient selection, treatment delivery and outcome assessments.
6. Treatment planning data can be correlated to clinical outcomes and improve predictive models of normal tissue complication (NTCP) and tumor control (TCP) probabilities

Future Directions

- IGRT
- SBRT
- IGBT
- Proton

IGRT for Prostate Cancer (Kestin)

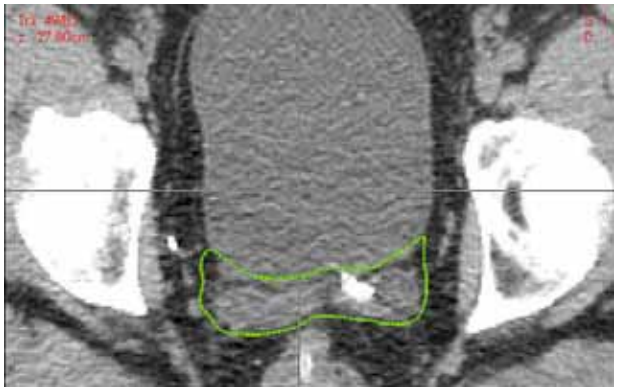
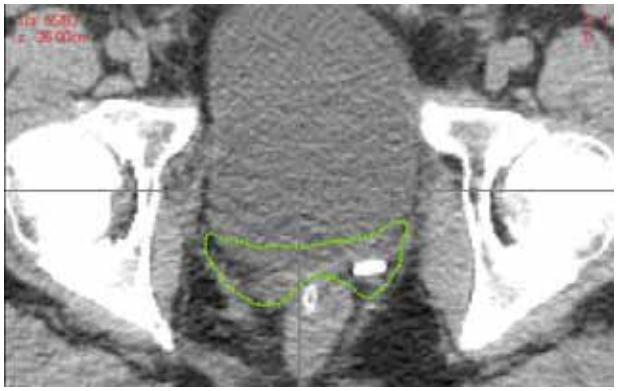
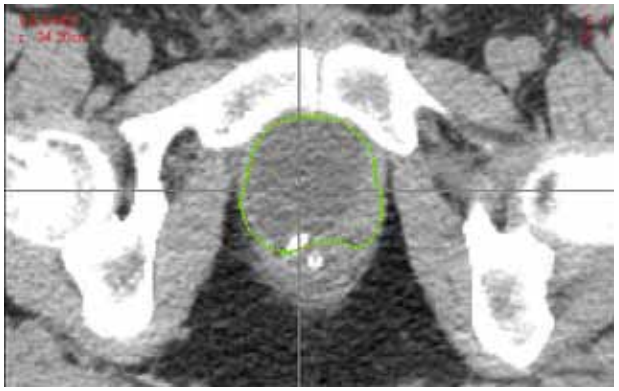
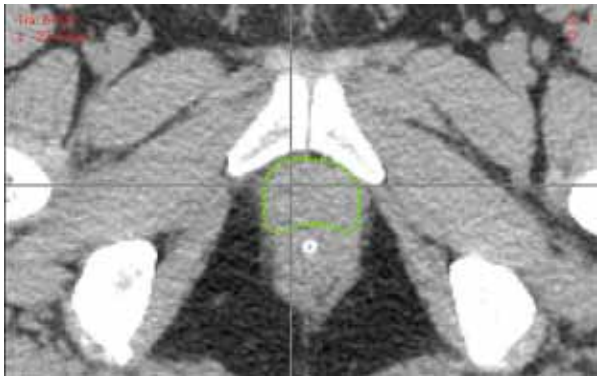
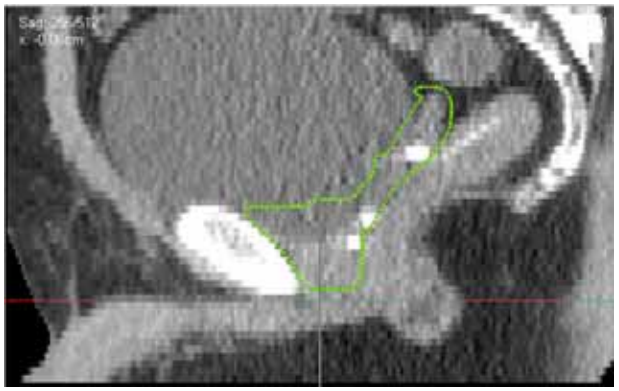
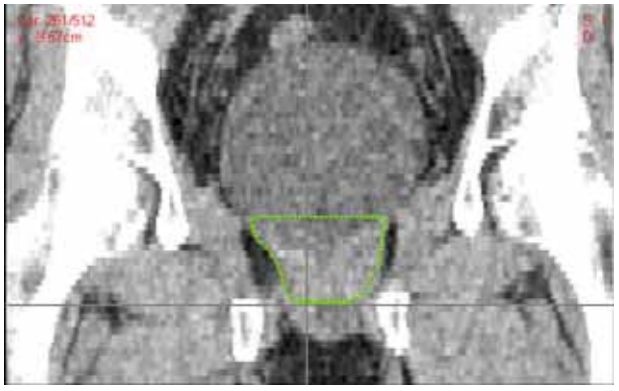
1. To collect 4D data obtained via various CT modalities (i.e. kV helical, MV helical, kV cone-beam, MV cone-beam) through the ATC for daily actual dose calculation and accurate modeling of TCP and NTCP of critical structures (i.e. rectum, bladder, penile bulb, femoral heads).
2. To assess the feasibility of submission and processing of 4D RT imaging data.
3. To compare single vs. multiple images for modeling of TCP and NTCP.
4. To determine an optimal number of images required for accurate modeling within a given confidence interval.
5. To determine shifts actually required for various CT-based localization techniques.
6. To determine the optimal margin for each localization technique for adequate dose delivery within a given confidence interval.
7. To quantify the dosimetric advantages of online vs. offline processes for each localization technique.

IGRT protocols

- Objectives
- Data collection
- Data analysis

Target and Normal Tissue Atlases

Prostate and Anal Cancers

IMRT guidelines

IMRT Guidelines

7. The protocol must provide a clear description of the prescription dose as well as dose heterogeneity permitted in the PTV, recognizing that dose heterogeneity will generally be greater with IMRT. The protocol must also specify the volume to be covered by the prescription dose (for example, the 60Gy isodose must cover 95% of the PTV). If 3D conformal and IMRT treatments are both allowed in a particular protocol, the dose heterogeneity requirements for IMRT and non-IMRT patients should be comparable.

RADIATION THERAPY ONCOLOGY GROUP

RTOG 0534

A PHASE III TRIAL OF SHORT TERM ANDROGEN DEPRIVATION WITH PELVIC LYMPH NODE OR PROSTATE BED ONLY RADIOTHERAPY (SPPORT) IN PROSTATE CANCER PATIENTS WITH A RISING PSA AFTER RADICAL PROSTATECTOMY

Study Chairs

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6.4.1.2 *PTV*

The PTV margins should be a minimum of 0.8 cm and a maximum of 1.5 cm in all dimensions. A reduction of the PTV margin from 0.8 cm to ≥ 0.6 cm to minimize rectal exposure will be considered a variation. A posterior margin of < 0.6 cm will be considered a protocol violation. A margin for penumbra (usually 0.5–0.7 cm beyond the PTV) should be added such that ≥ 95% of the PTV receives the prescribed dose. Care should be taken to conform the prescribed dose as closely to the PTV as possible, so as to avoid including the entire width of the rectum in the posterior blocked margin at the bladder neck-rectum interface.The maximum dose heterogeneity allowable in the PTV will be 7%; a variation will

6.4.2 Prostate Bed Planning for IMRT

6.4.2.1 *CTV/PTV/Normal Tissues*

The CTV and PTV will be the same as for 3D-CRT; there is no need to add margin for penumbra. A series of dose-volume histograms will be generated and analyzed to determine the adequacy of the plan.

6.4.2.2 *Planning Parameters*

The plan will be deemed acceptable under the following conditions.

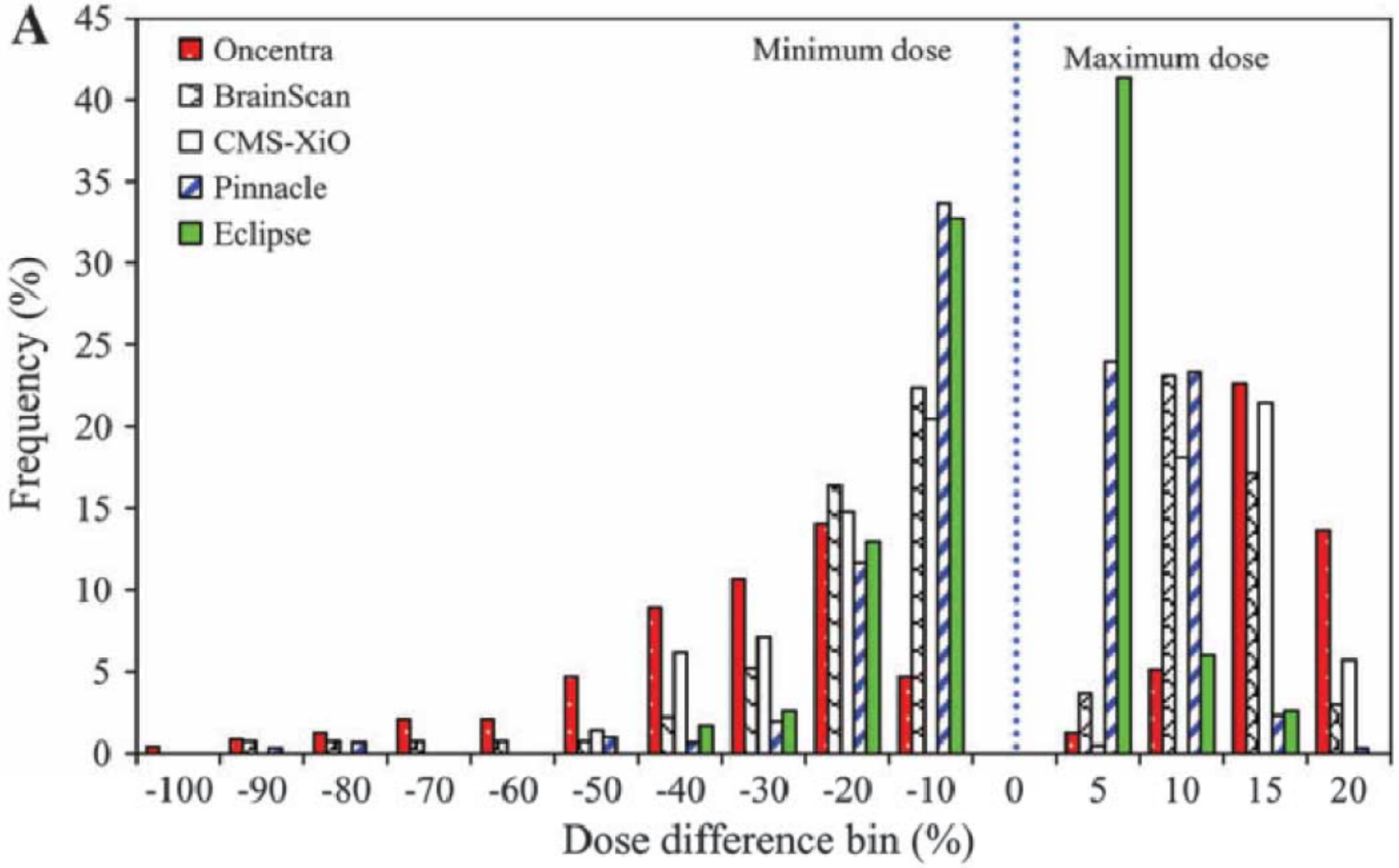
PTV: The dose marker levels for bladder and rectum have been modeled after prior studies in men treated definitively with IMRT for prostate cancer.[84-85] At least 95% of the PTV should receive the prescribed dose (64.8-70.2 Gy); a variation will be noted if < 95% to 90% of the PTV receives the prescribed dose, and a protocol violation will be noted if < 90% of the PTV receives the prescribed dose. The maximum dose heterogeneity allowable in the PTV will be 15%; a variation will be > 15% and a violation > 20%. Since the dose is prescribed to the minimum isodose line of the PTV, the dose variability is seen in portions of the target volume receiving higher than the specified dose.

Rectum: Less than or equal to 25% and 45% of the rectum should receive ≥ 65 Gy and ≥ 40 Gy, respectively. A variation will be noted if up to an additional 7.5% of the rectal volume receives above the target doses specified. The inclusion of rectal volumes beyond these constraints will be considered a protocol violation.

Bladder: Less than or equal to 40% and 60% of the bladder (minus prostate bed CTV) should receive ≥ 65 Gy and ≥ 40 Gy, respectively. The criteria for the bladder have been relaxed because the dosimetric relationship of volume exposed to the specified marker doses is much less clear and the bladder neck is included in the CTV. A primary variation will be noted if up to an additional 7.5% of the bladder volume receives above the target doses specified. The inclusion of bladder volumes beyond these constraints will be considered a secondary protocol variation; it will not be considered a protocol violation.

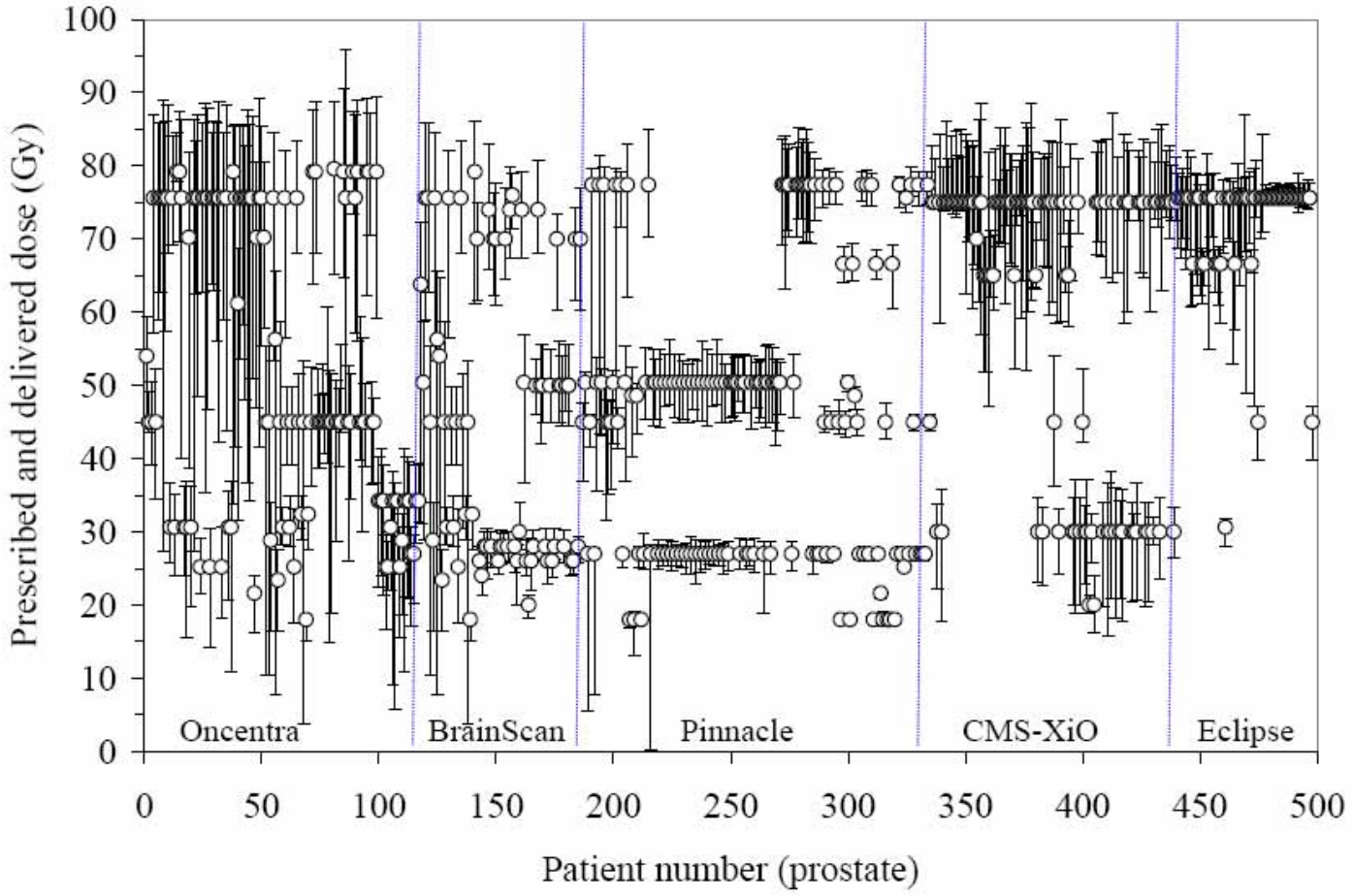
Das IMRT Paper

Das JNCI 2008

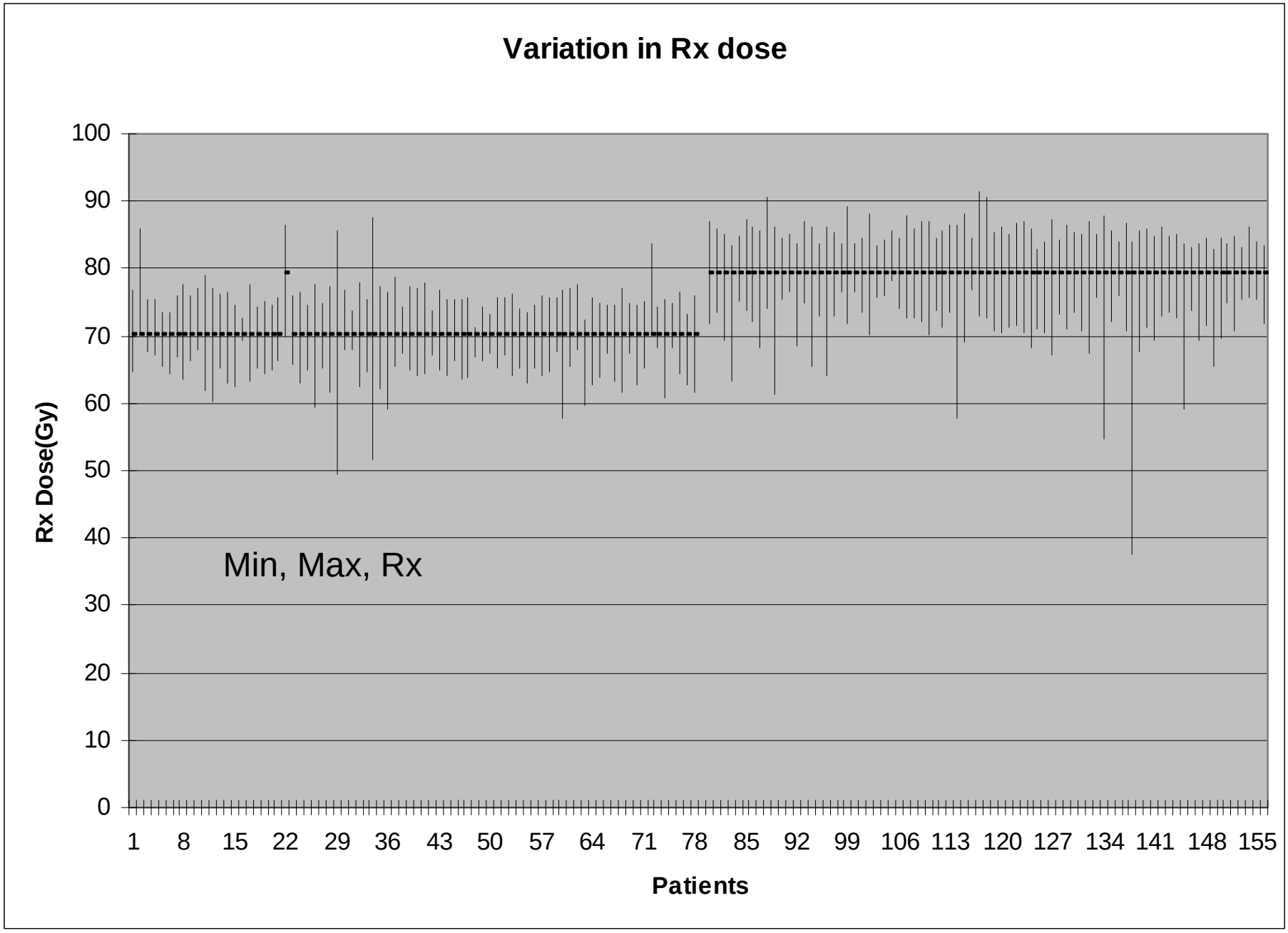


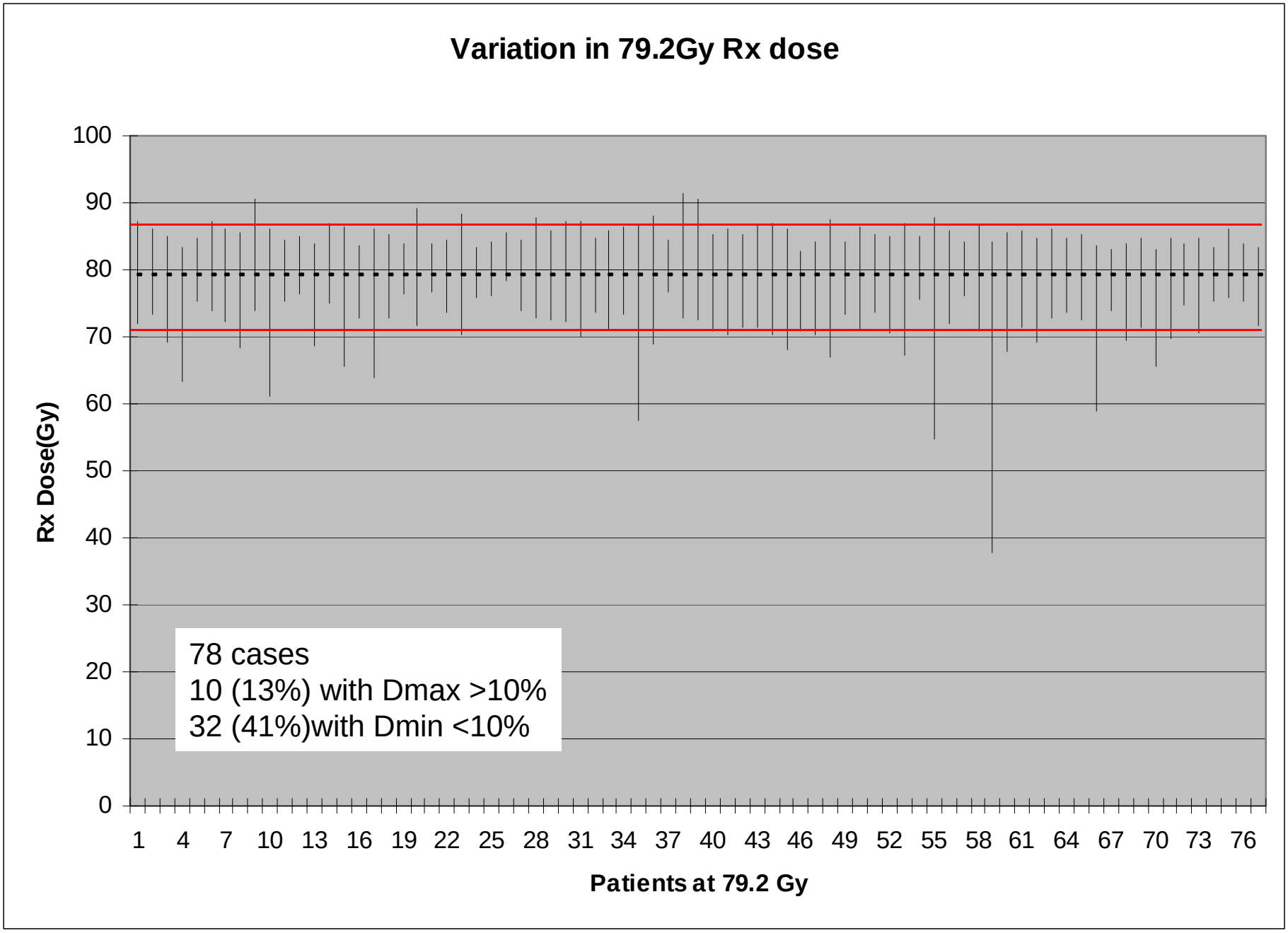
49% of prostate patients deviated more than +/- 10%

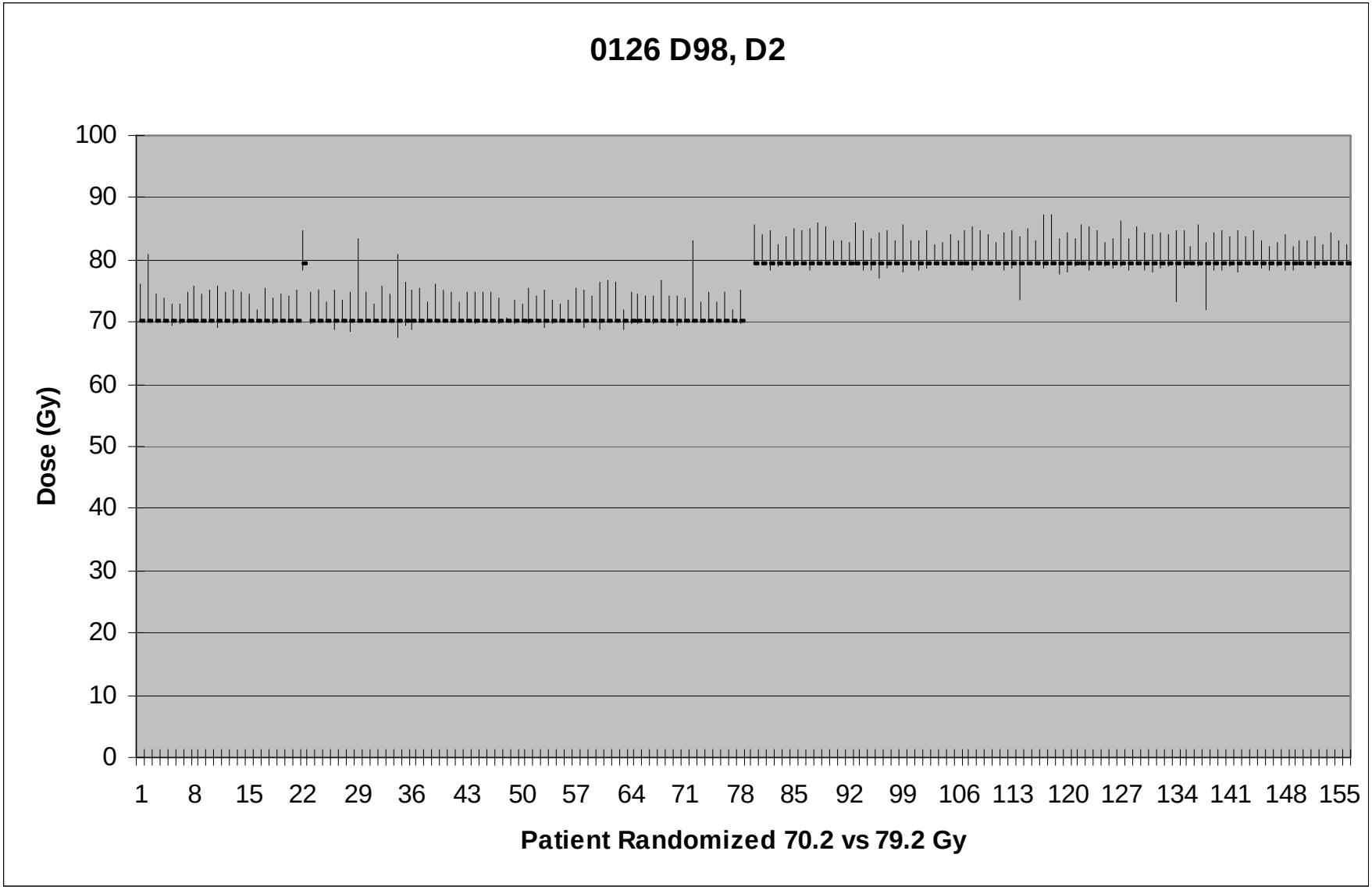
Das JNCI 2008

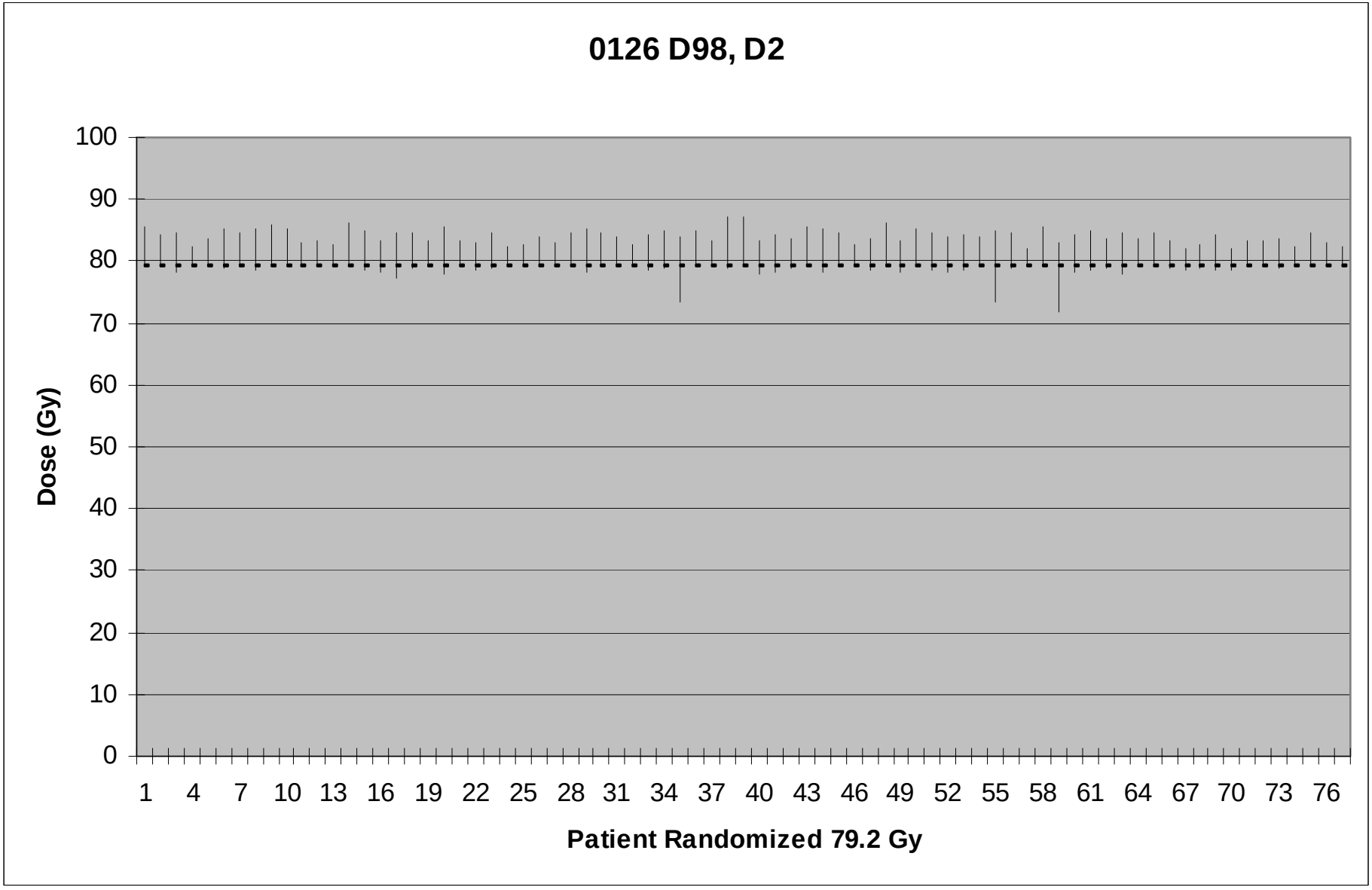


RTOG IMRT prostate


Variation in Rx dose
Rx Dose(Gy)
100
90
80
70
60
50
40
30
20
10
0
Min, Max, Rx
1
8
15
22
29
36
43
50
57
64
71
78
85
92
99
106
113
120
127
134
141
148
155
Patients


Variation in 79.2Gy Rx dose
Rx Dose(Gy)
100
90
80
70
60
50
40
30
20
10
0
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76
Patients at 79.2 Gy
78 cases
10 (13%) with Dmax >10%
32 (41%)with Dmin <10%


0126 D98, D2
Dose (Gy)
100
90
80
70
60
50
40
30
20
10
0
1
8
15
22
29
36
43
50
57
64
71
78
85
92
99
106
113
120
127
134
141
148
155
Patient Randomized 70.2 vs 79.2 Gy


0126 D98, D2
100
90
80
70
60
50
40
30
20
10
0
Dose (Gy)
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76
Patient Randomized 79.2 Gy