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EASTERN TIME [GMT-4]

Determination of the optimal fall-off value for the NTO in centrally located lung masses and prostate patients

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INTRODUCTION

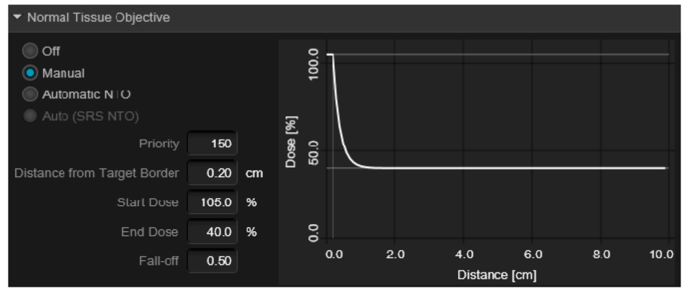
When using the Photon Optimizer in Eclipse you are able to use the Automatic Normal Tissue Objective (NTO) or the Manual NTO. When using the Manual NTO, you can select the Priority, Distance from Target Border, Start Dose, End Dose, and Fall-Off. These settings are going to affect how the dose falls off outside of your target volume in normal tissues. This, in turn, will affect your coverage and maximum dose for the plan. At our clinic we have found that we generally get better plans when using the Manual NTO versus the Automatic NTO.

AIM

This project was designed to find the optimal Fall-off value for the NTO for centrally located lung masses using a SBRT technique and for prostate plans using VMAT.

METHOD

Using a computational human phantom series provided by the NCI and Photon Optimizer (PO version 15.6.05), plans containing different Fall-offs in the NTO were calculated in Eclipse (AAA version 15.6.05). For the prostate plans, a lower and upper objective was set at 100% and 105% of the prescription dose in the PO, respectively. For the lung plans, only a lower objective of 100% was used. Each NTO had a Start Dose of 105%, an End Dose of 40%, and a Distance from Target Border objective set at 0.20 cm. Fall-off values varied from 0.1 up to 10. All NTO and PTV objectives used a priority of 150. Percentage decrease in dose from 0.2 to 2.0 cm, maximum dose, and PTV coverage were evaluated to determine the optimal Fall-off.

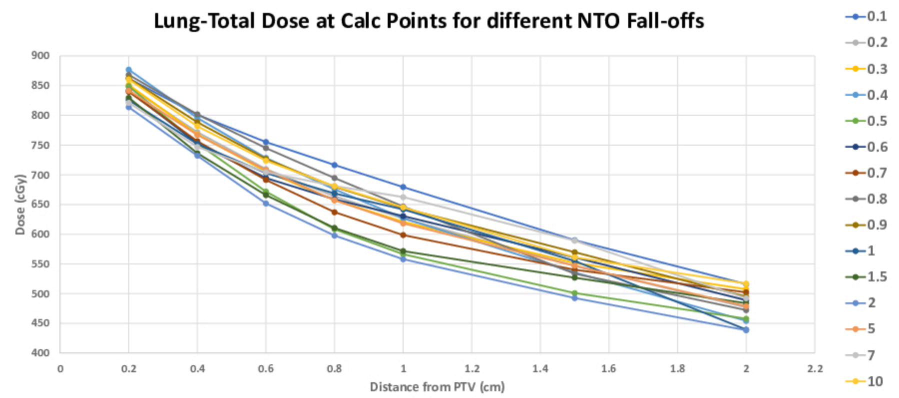


RESULTS

None of the plans were normalized after they were calculated. To find the decrease in dose, the doses at 0.2 cm and 2.0 cm from the target were compared. See images below for plan examples.

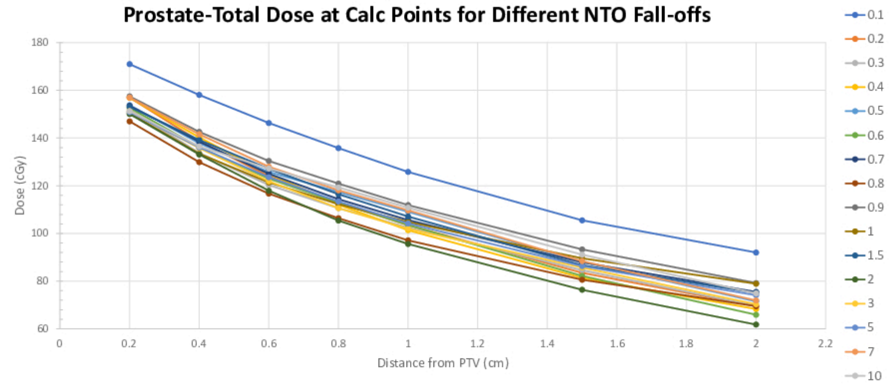
For the prostate plans, PTV coverage decreased with increasing Fall-off, but was above 97.2% for all plans. The maximum dose was never greater than 107.2%. The greatest decrease in dose occurred with a Fall-off of 2.0, 0.6, and 0.4, respectively.

For the lung plans, PTV coverage stayed above 98.7% for every Fall-off. A maximum dose greater than 125% occurred when the Fall-off was 0.2 and below or 0.9 and above. Using Fall-off values of 0.4 and 0.5 resulted in the greatest decrease in dose while keeping the maximum dose below 125%.



PTV Lung Dose Statistics

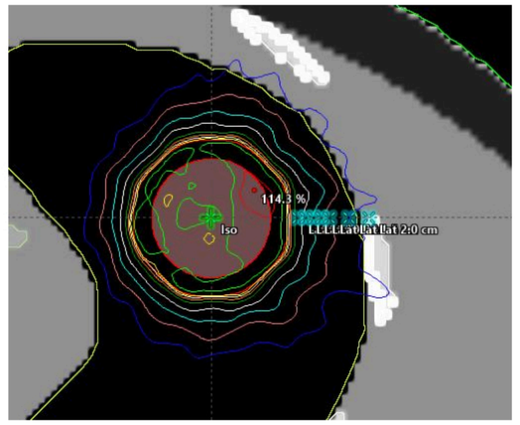
Fall-off	Max Dose (%)	Min Dose(%)	V5000cGy (%)	Decrease in dose (%)
0.1	206.7	99.1	99.9	-40.2
0.2	125.9	97.6	99.9	-43.8
0.3	123.4	97.4	99.2	-40.4
0.4	120.4	95.6	99.0	-48.2
0.5	121.4	96.7	98.9	-46.1
0.6	122.2	96.1	99.3	-41.9
0.7	124.4	96.8	99.2	-40.2
0.8	123.6	96.1	99.6	-45.6
0.9	129.3	97.3	99.3	-42.6
1.0	125.6	96.4	99.0	-46.8
1.5	130.0	95.5	99.1	-41.7
2.0	128.2	96.0	99.4	-46.1
3.0	130.0	96.2	99.1	-40.4
5.0	132.6	95.2	99.3	-43.1
7.0	130.7	96.3	99.1	-40.1
10.0	137.7	96.2	98.7	-39.9

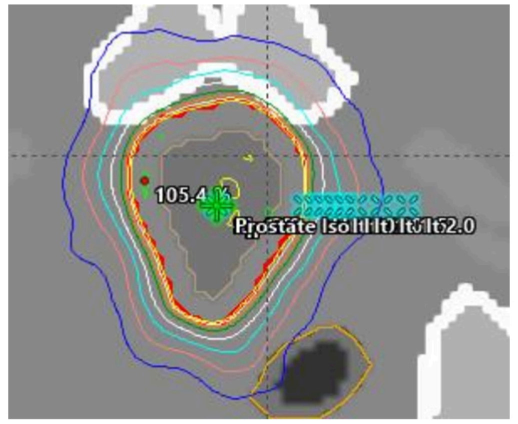


PTV Prostate Dose Statistics

Fall-off	Max Dose (%)	Min Dose(%)	V8100cGy (%)	Decrease in dose (%)
0.1	105.6	99.2	100.0	-46.2
0.2	105.7	98.4	99.7	-55.7
0.3	106.4	97.6	99.3	-54.2
0.4	106.5	96.2	99.0	-56.5
0.5	106.2	95.8	98.3	-53.5
0.6	106.9	96.3	98.4	-56.8
0.7	106.9	95.4	97.9	-50.8
0.8	106.9	95.4	98.0	-52.7
0.9	106.7	95.3	98.0	-49.7
1.0	106.6	95.2	98.2	-47.6
1.5	106.8	95.0	98.0	-50.9
2.0	107.0	95.1	97.5	-58.8
3.0	106.9	94.0	97.5	-53.5
5.0	107.2	93.8	97.2	-50.9
7.0	107.1	94.2	97.3	-54.2
10.0	106.9	94.1	97.4	-50.5

PHANTOM AND CALC POINT IMAGES





Half Arcs were used for the SBRT Lung plans, whereas Full Arcs were used for the VMAT Prostate Plans. Both of these images show a Falloff value of 0.5.

CONCLUSIONS

For our clinic guidelines, in order to maintain optimal coverage, with an acceptable hot spot and large dose falloff, a NTO Fall-off value between 0.4 and 0.6 should be used. These values have been shown to give the greatest dose falloff, while still maintaining excellent coverage with an acceptable maximum dose in VMAT prostate and SBRT lung plans.

The NTO values may need to be adjusted depending on the optimization structures and target volume but using these values will provide a good starting point for the plan.

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