Renown HEALTH

Thanks to Dosimetry and Physics Group at Renown

AAMD
American Association of Medical Dosimetrists

The Language of planning

Qualifier – Renown Equipment
Your equipment

Question 1: In treatment Planning, when does the conversation actually Start?

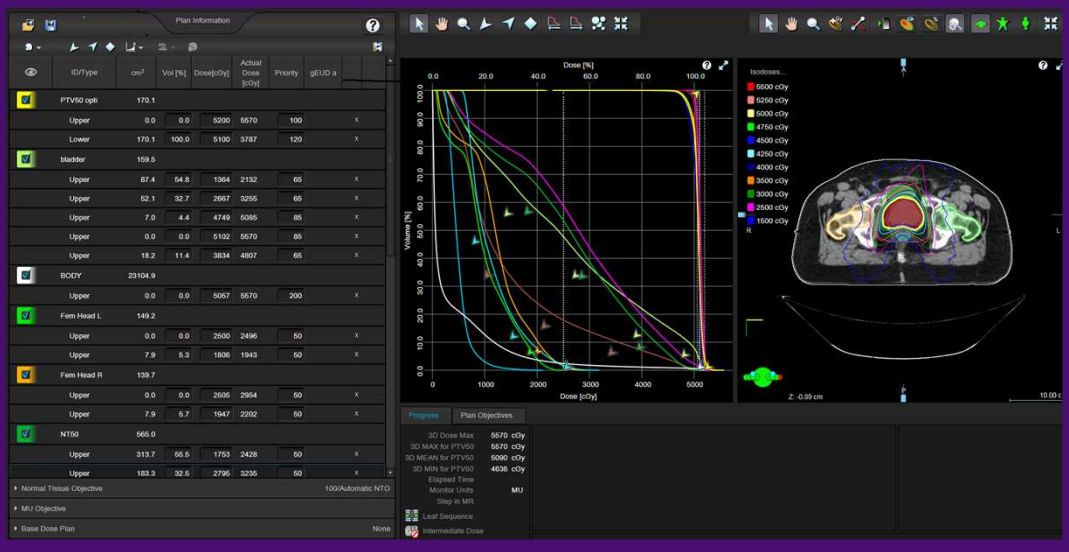
Question 2: How much difference does what I say really make?

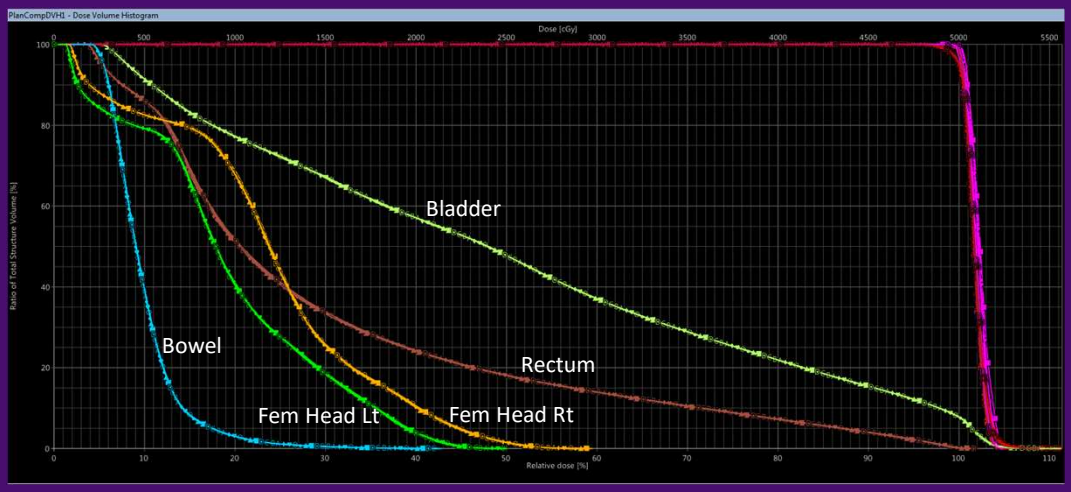
Question 3: What did we do to Evaluate?

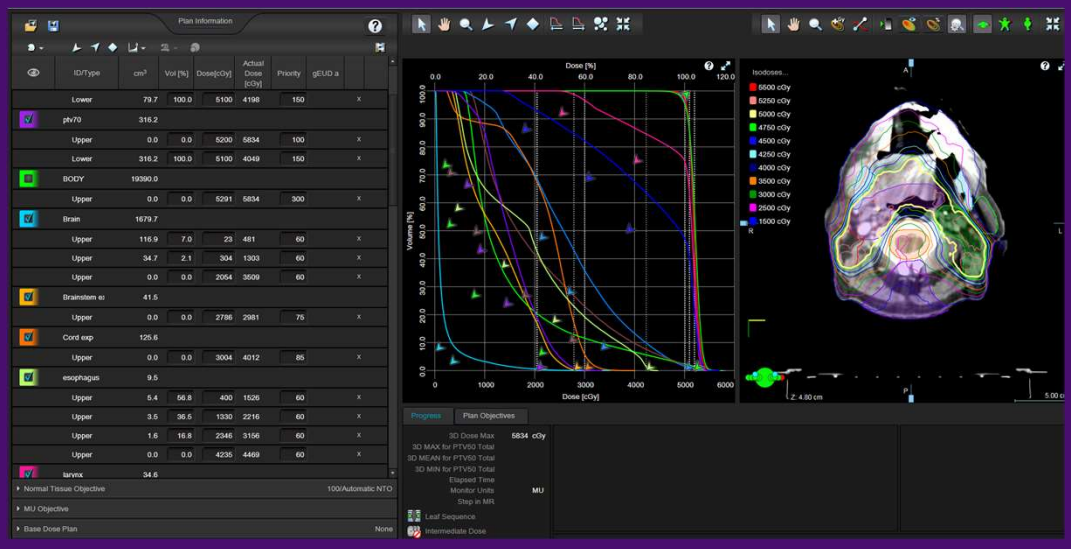
Question 3: How did we evaluate? Let's start with question 3.

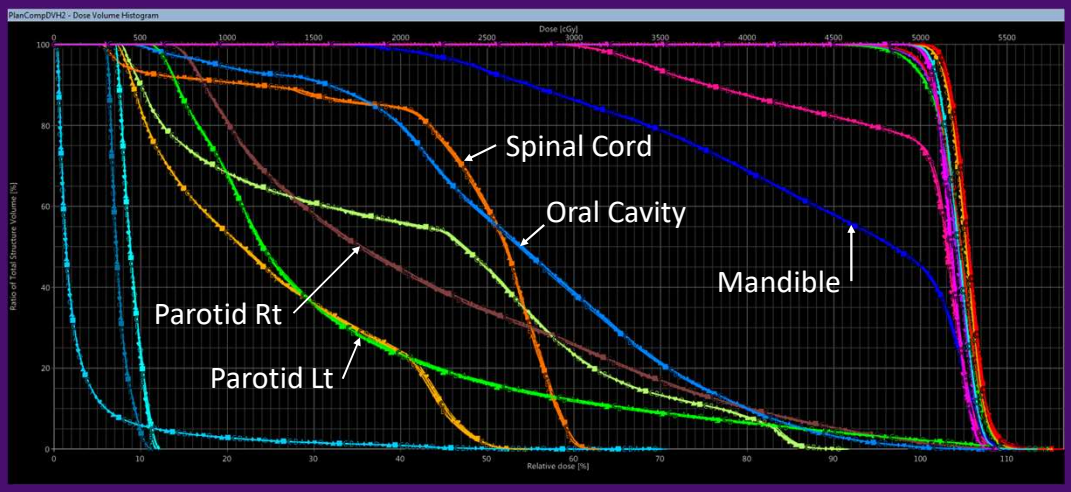
Baseline

- Existing Patient
- Existing Optimization Criteria
- Utilized Non-Adjusted Optimization Parameters
- Allowed Plan to Run Through Optimization Undisturbed
- Normalized, then Evaluated Same plan 10 times




PlanCompDVH1 - Dose Volume Histogram
Dose [cGy]
Ratio of Total Structure Volume [%]
Relative dose [%]
Bladder
Bowel
Rectum
Fem Head Lt
Fem Head Rt


Plan Information
ID/Type
Dose [%]
Dose [cGy]
Volume [%]
Isodoses...
Progress
Plan Objectives



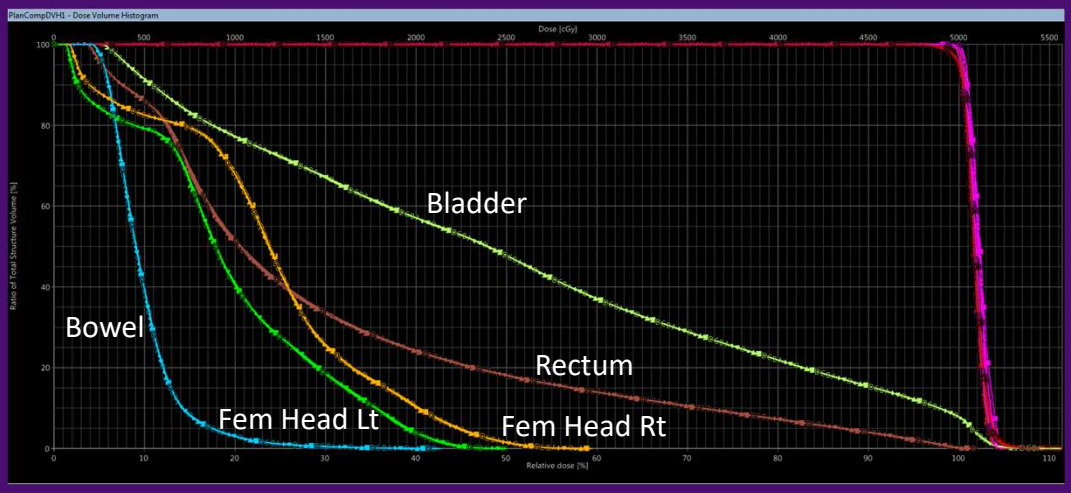
Question 1: In treatment Planning, when does the conversation actually Start?

Question 2: How much difference does what I say really make?

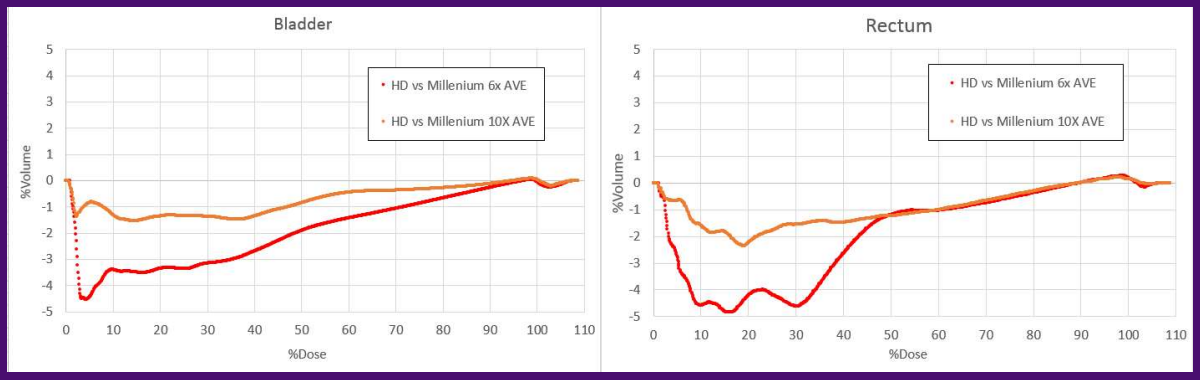
Let's Backtrack to the beginning, play and find out

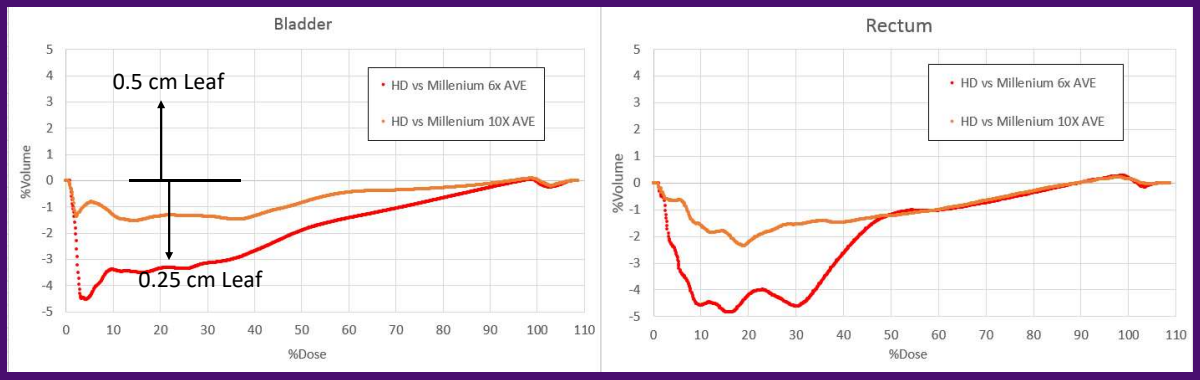
Software Version

Software Version
Recent Software update

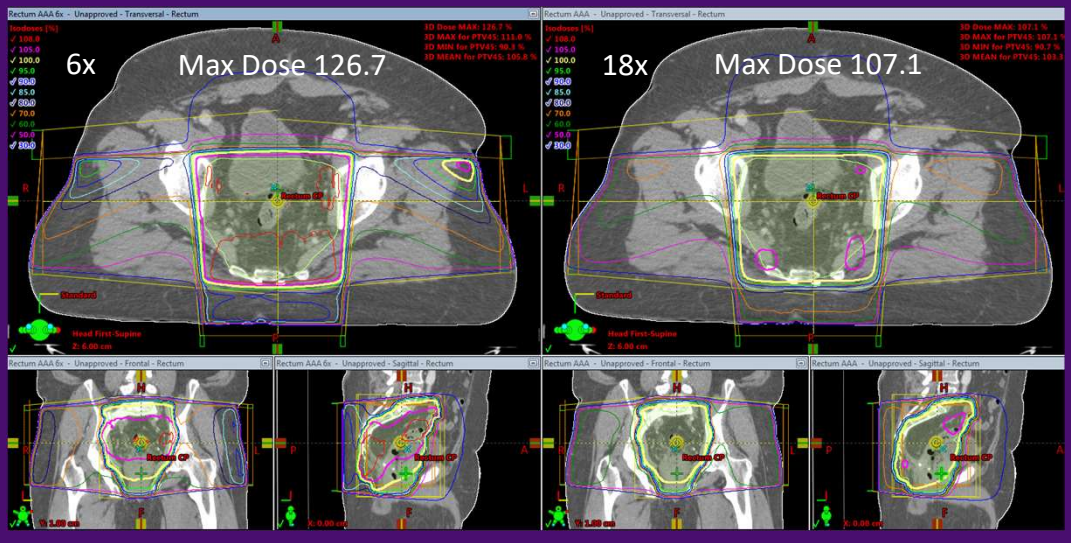


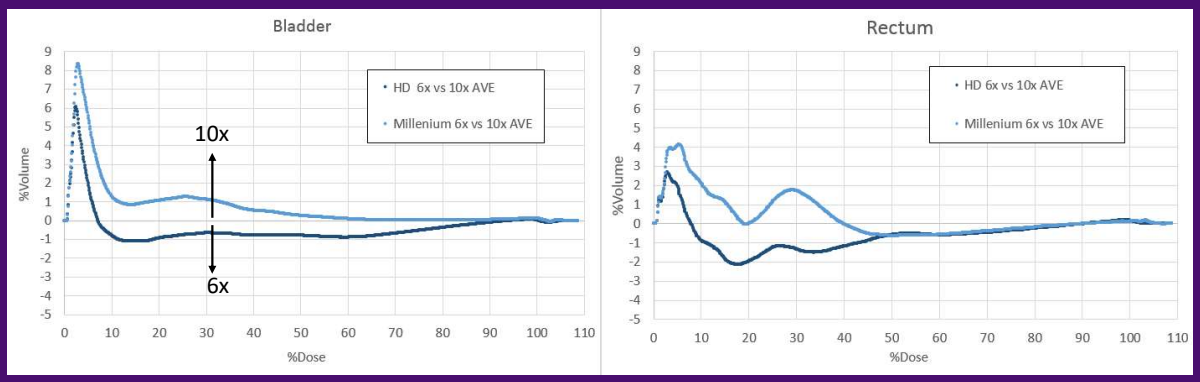
Treatment Machine Choice
(Leaf Width)


Bladder
HD vs Millenium 6x AVE
HD vs Millenium 10X AVE
%Volume
%Dose
Rectum
HD vs Millenium 6x AVE
HD vs Millenium 10X AVE
%Volume
%Dose

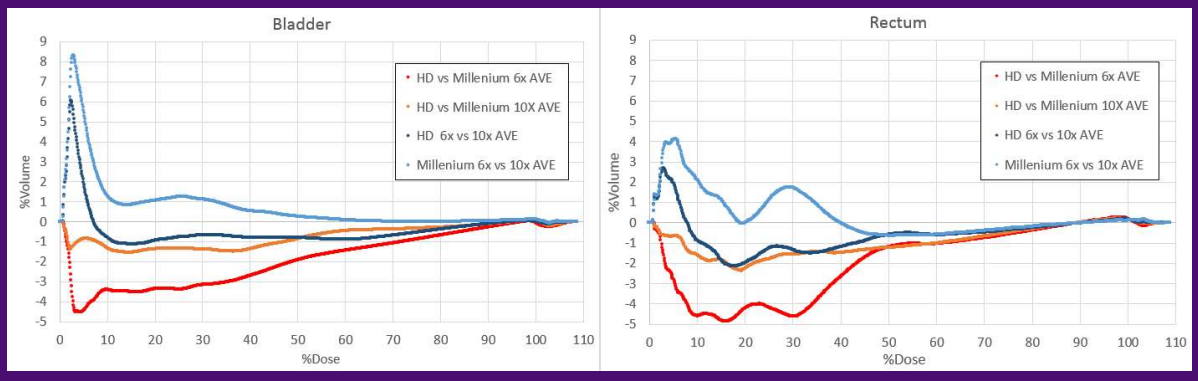

Bladder
0.5 cm Leaf
0.25 cm Leaf
HD vs Millenium 6x AVE
HD vs Millenium 10X AVE
%Volume
%Dose
Rectum
HD vs Millenium 6x AVE
HD vs Millenium 10X AVE
%Volume
%Dose

Energy Selection

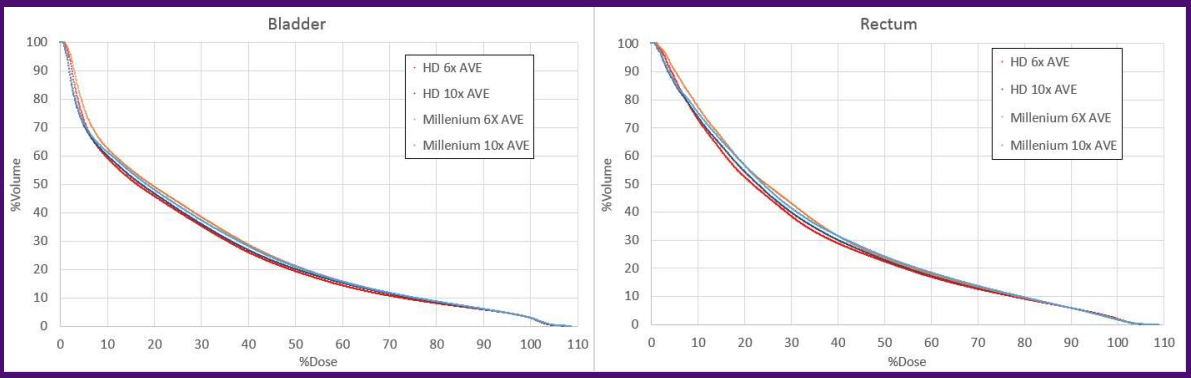




Total Difference for Bladder and Rectum, Leaf Width and Energy

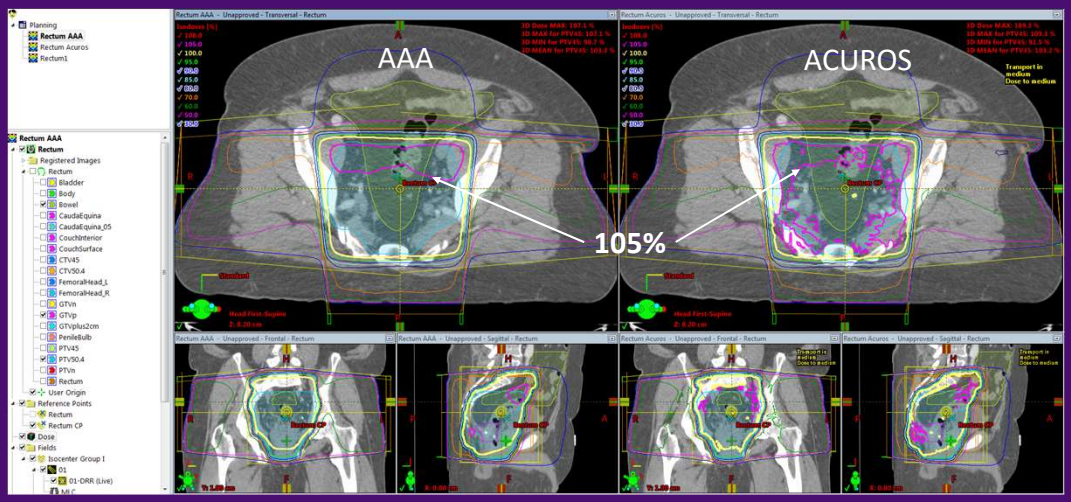


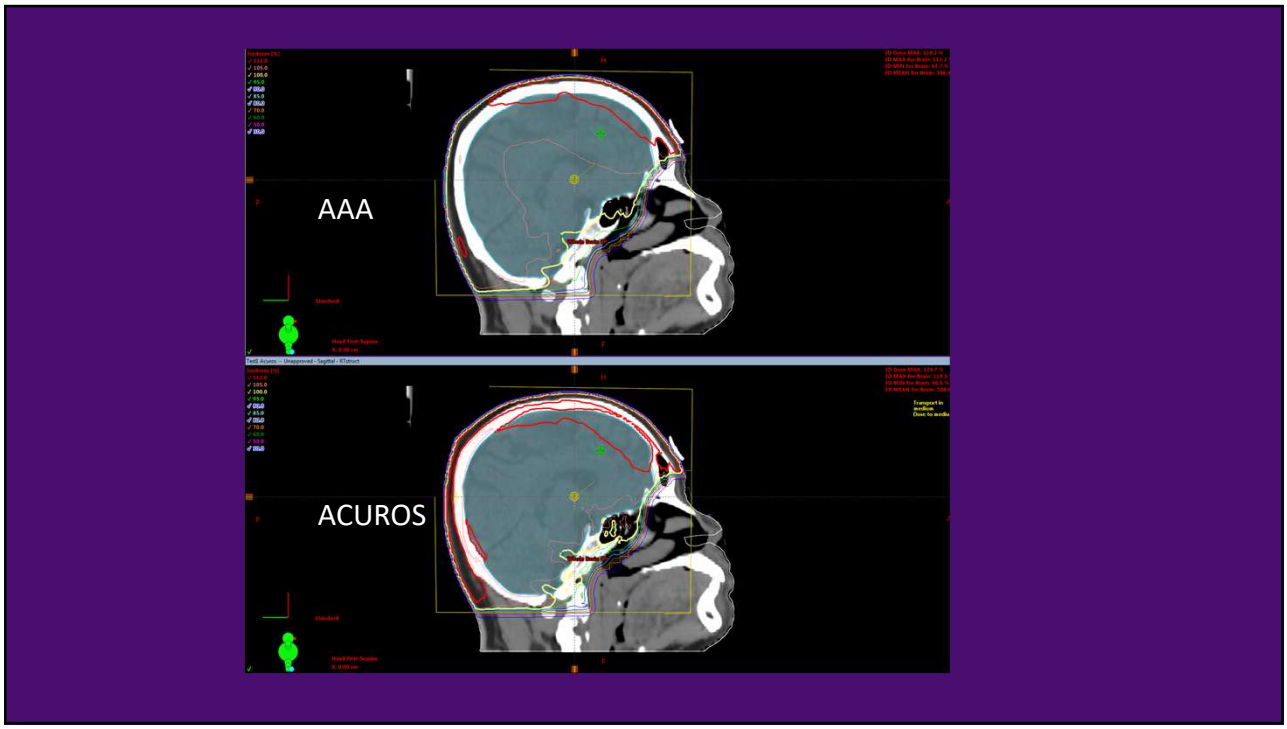
Total Difference for Bladder and Rectum, Leaf Width and Energy

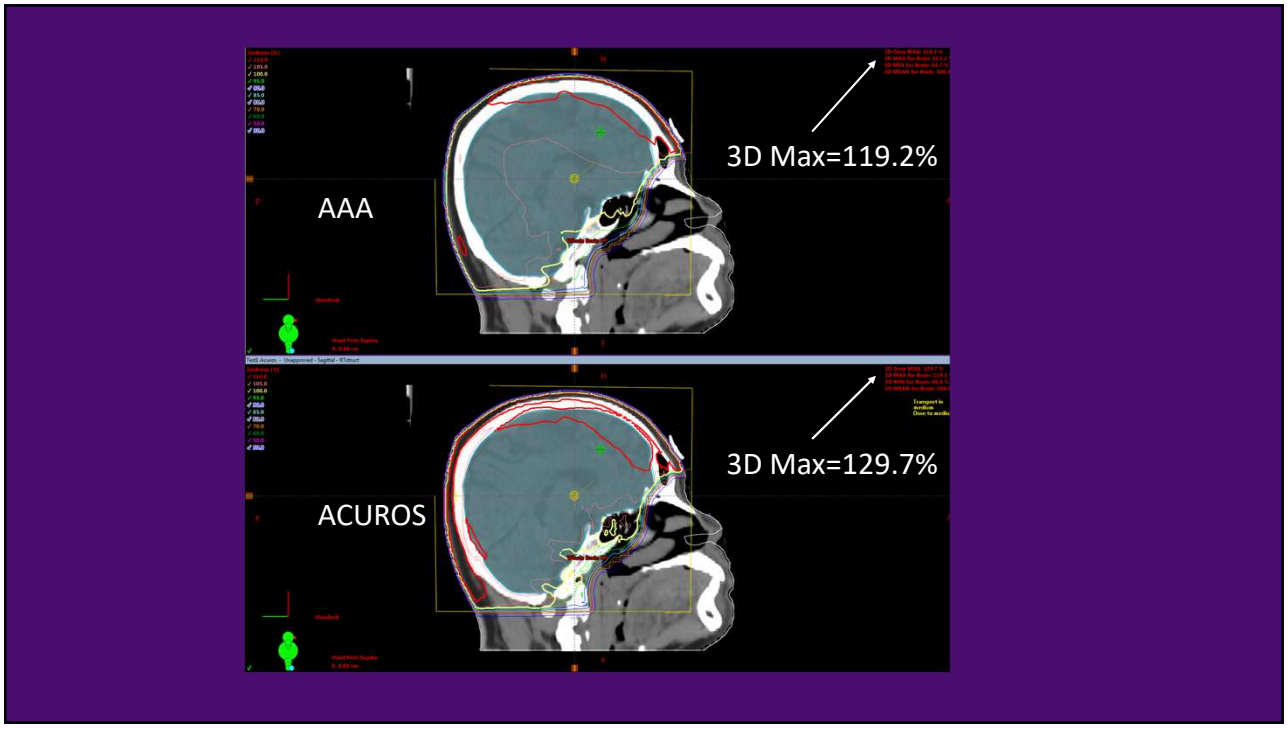


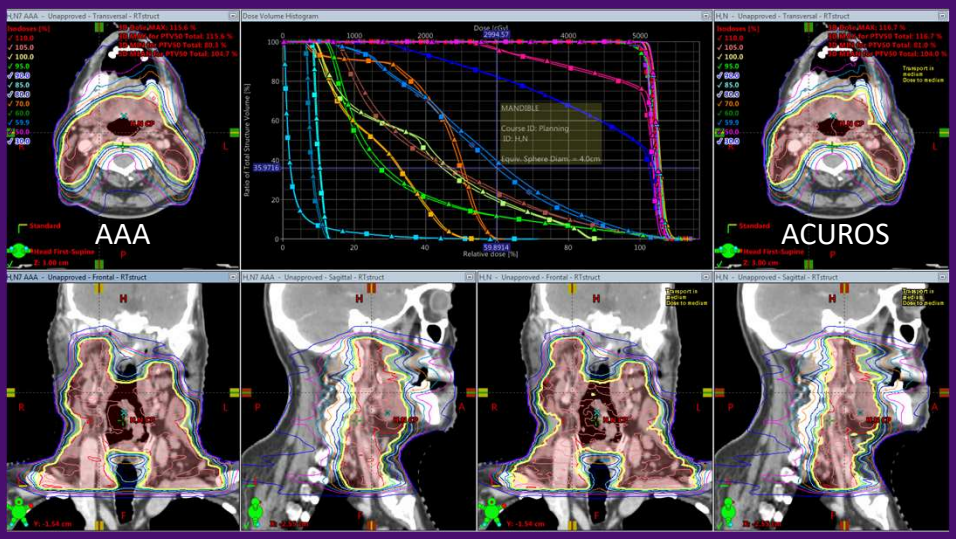
Planning Algorithm

Planning Algorithm
AAA – 3D Pencil Beam
Acuros – Simplified Monte Carlo

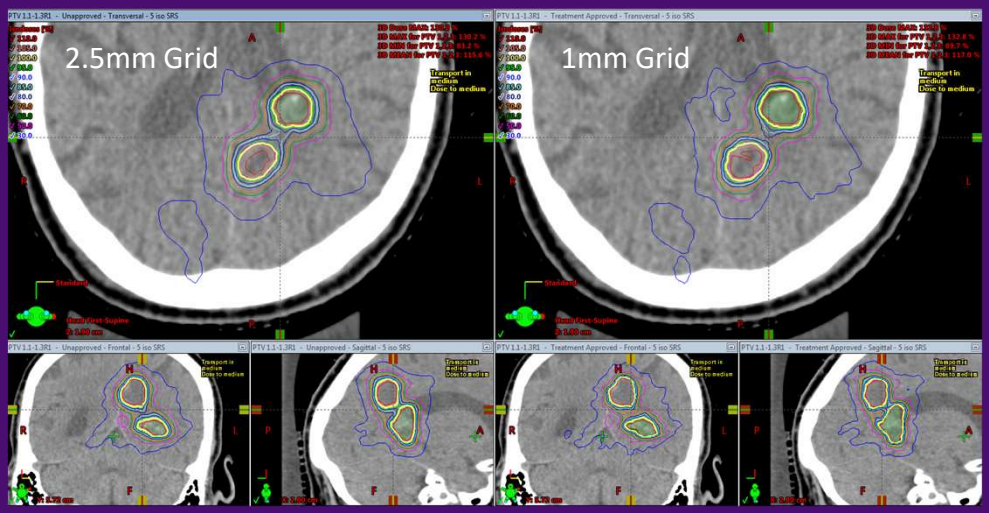


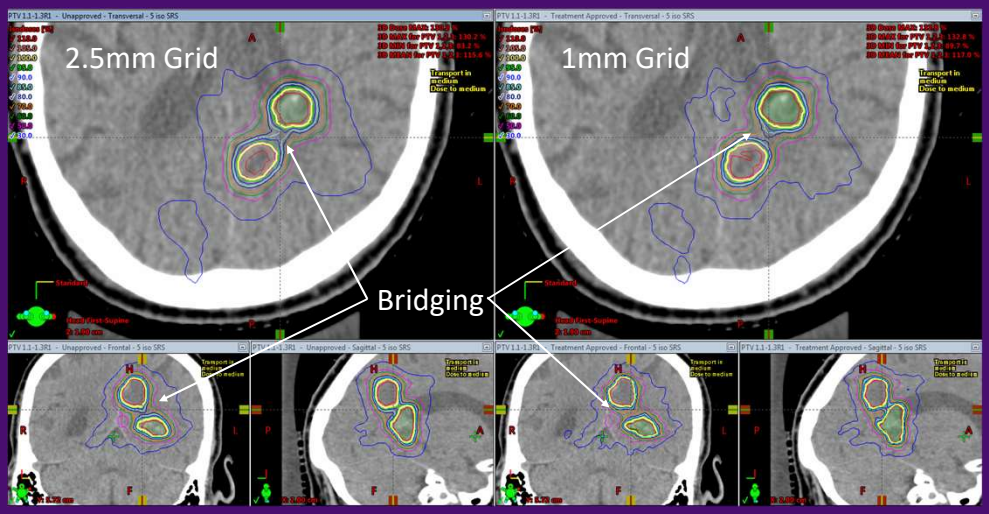

AAA
ACUROS

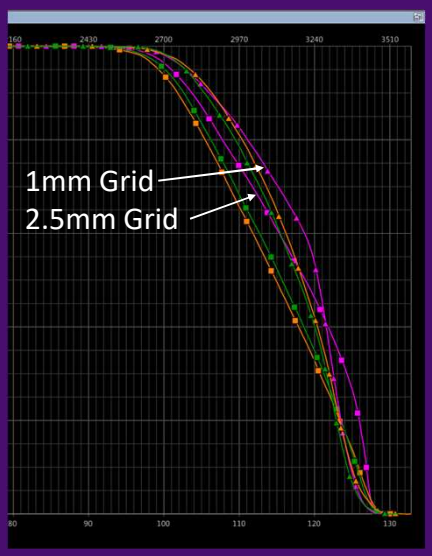

AAA
3D Max=119.2%
ACUROS
3D Max=129.7%



Grid Spacing

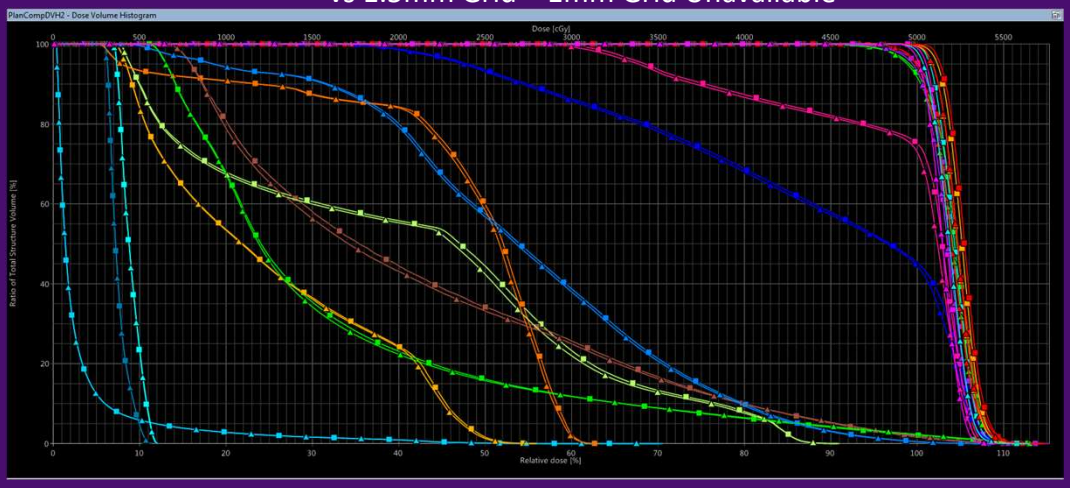

2.5mm Grid
1mm Grid


2.5mm Grid
1mm Grid
Bridging



Acuros, 2.5mm Grid
vs 1.5mm Grid

Acruos, 2.5mm Grid
vs 1.5mm Grid – 1mm Grid Unavailable



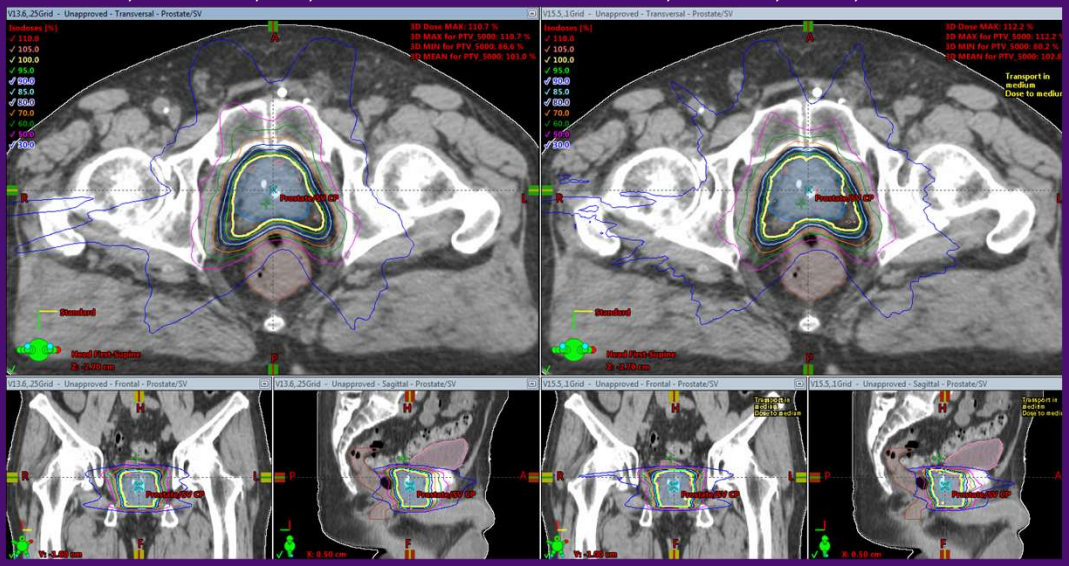
Combined Effect

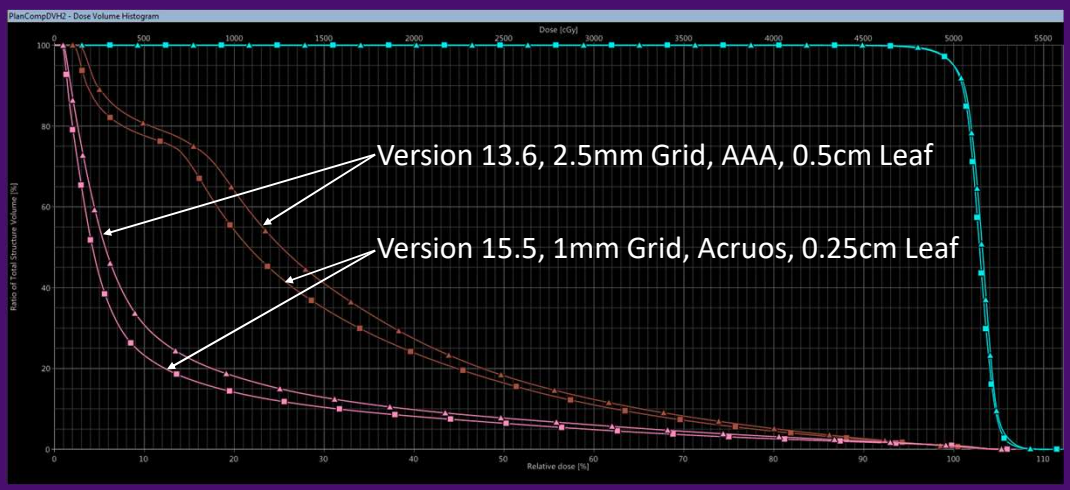
Combined Effect
Worst case to Best

Combined Effect
Worst case to Best
(SO FAR!!!)

Version 13.6, 2.5mm Grid, AAA, 0.5cm Leaf

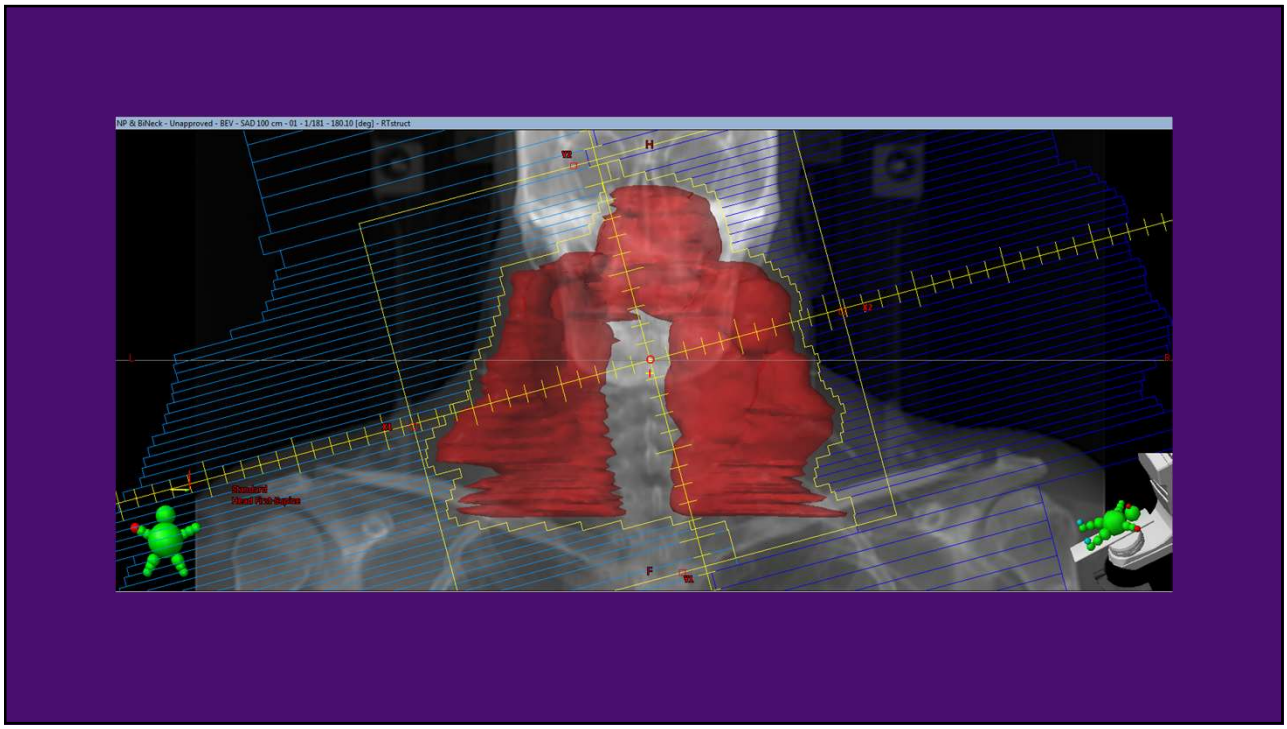
Version 15.5, 1mm Grid, Acruos, 0.25cm Leaf

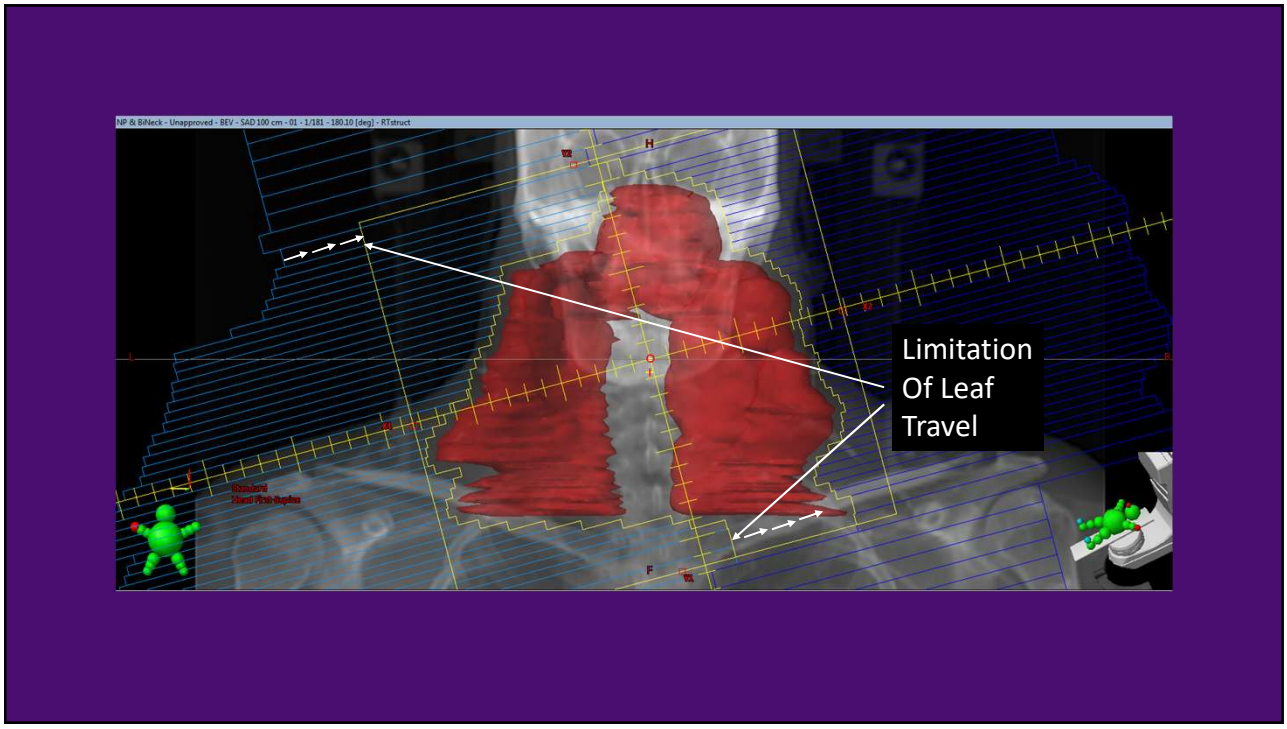


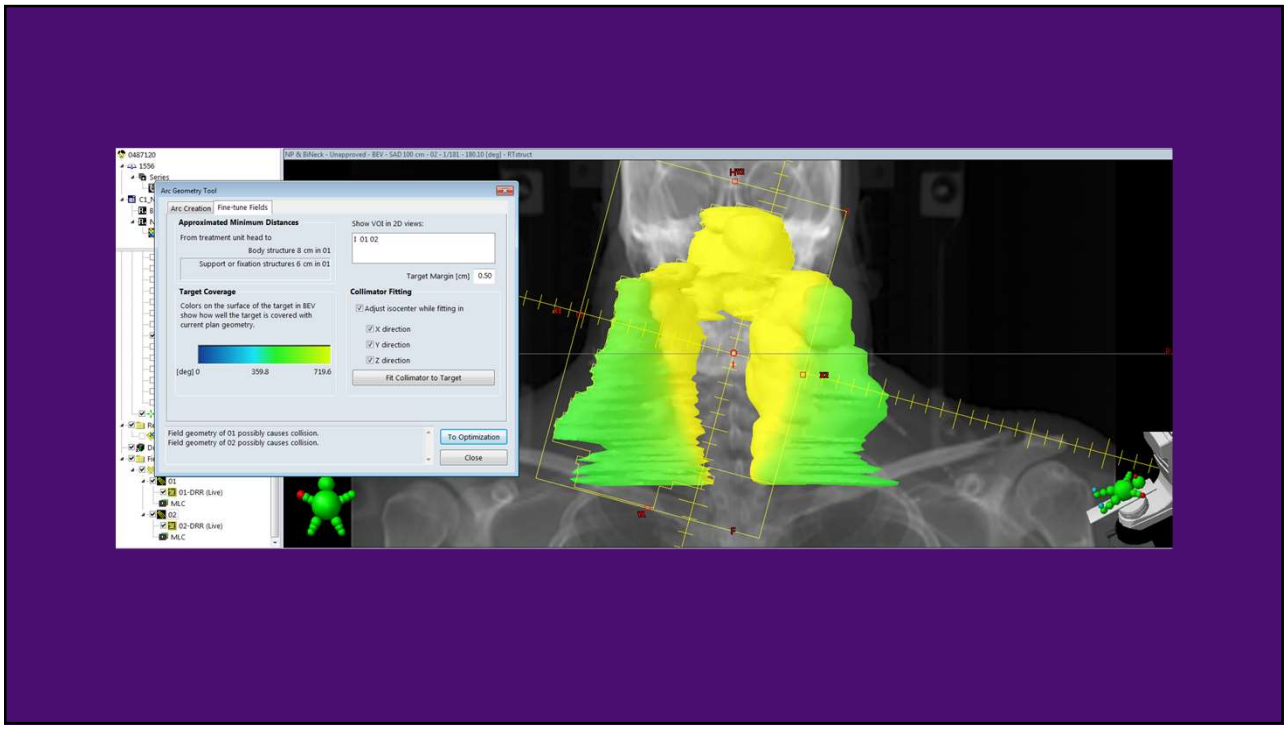


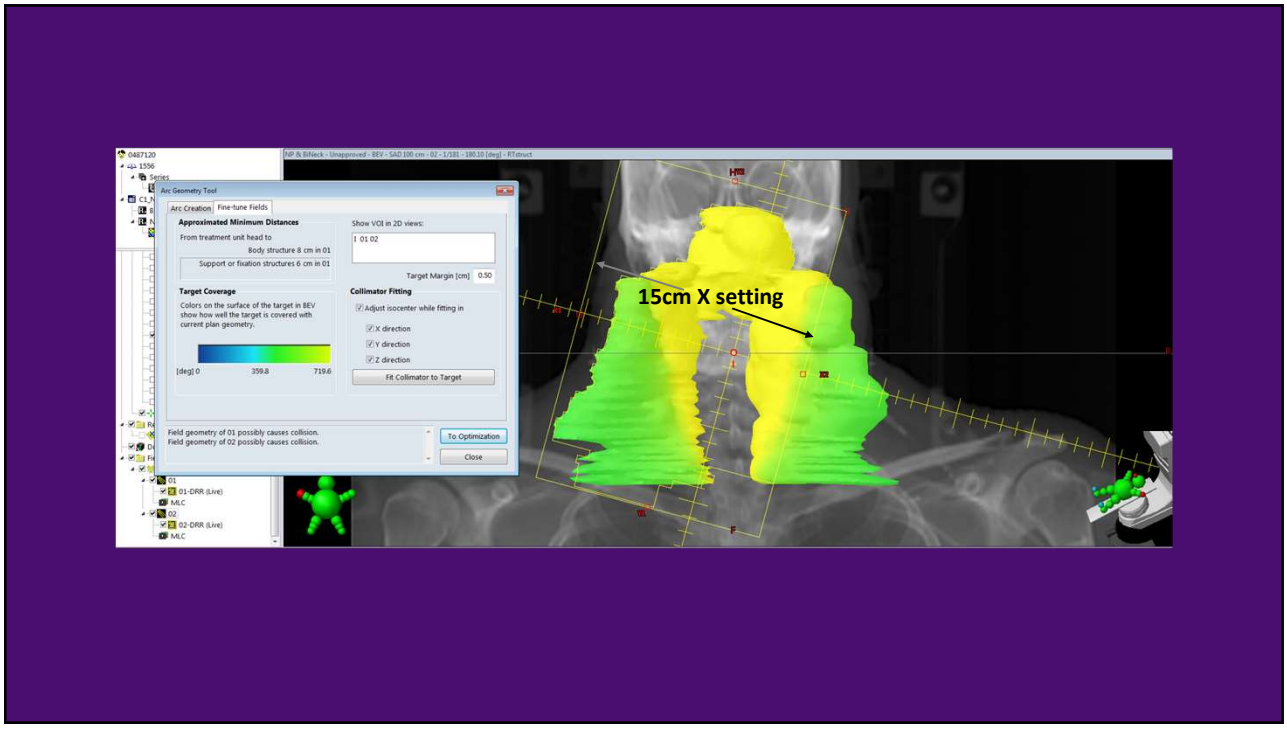
Let's Keep Going

Field Size


NP & BiNeck - Unapproved - BEV - SAD 100 cm - 01 - 1/181 - 180.10 [deg] - RTstruct
H
F

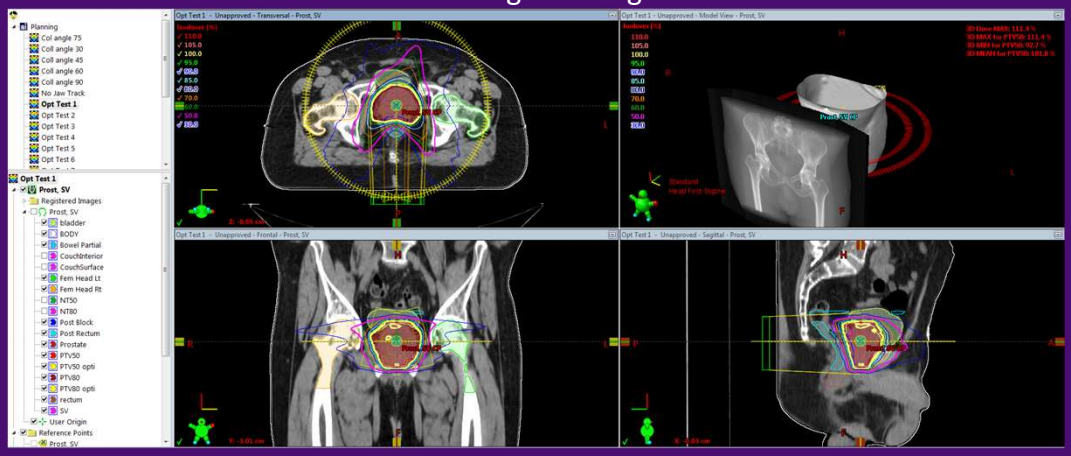

NP & BiNeck - Unapproved - BEV - SAD 100 cm - 01 - 1/181 - 180.10 [deg] - RTstruct
H
F
Limitation
Of Leaf
Travel


Arc Geometry Tool
Arc Creation
Fine-tune Fields
Approximated Minimum Distances
From treatment unit head to
Body structure 8 cm in 01
Support or fixation structures 6 cm in 01
Show VOI in 2D views:
1 01 02
Target Margin [cm] 0.50
Target Coverage
Colors on the surface of the target in BEV show how well the target is covered with current plan geometry.
[deg] 0
359.8
719.6
Collimator Fitting
Adjust isocenter while fitting in
X direction
Y direction
Z direction
Fit Collimator to Target
Field geometry of 01 possibly causes collision.
Field geometry of 02 possibly causes collision.
To Optimization
Close

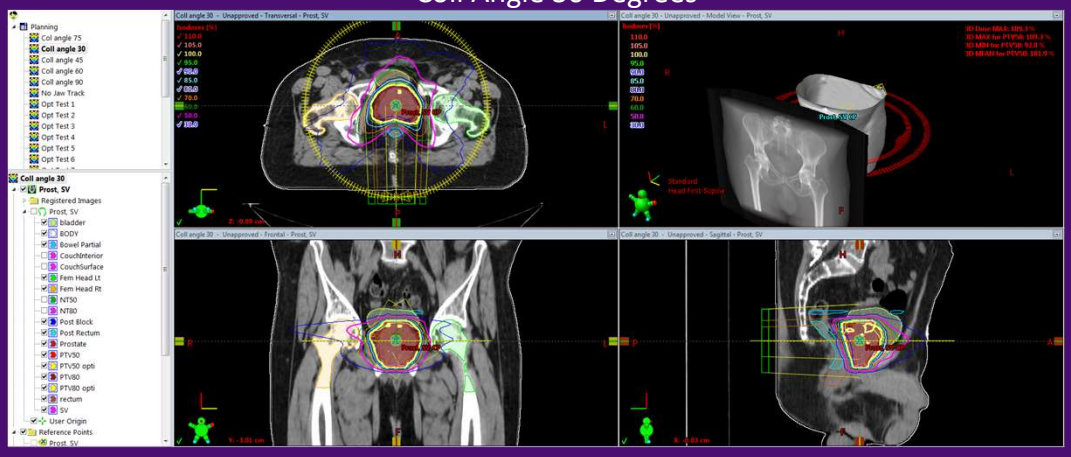

Arc Geometry Tool
Arc Creation
Fine-tune Fields
Approximated Minimum Distances
From treatment unit head to
Body structure 8 cm in 01
Support or fixation structures 6 cm in 01
Show VOI in 2D views:
1 01 02
Target Margin [cm] 0.50
Target Coverage
Colors on the surface of the target in BEV show how well the target is covered with current plan geometry.
[deg] 0
359.8
719.6
Collimator Fitting
Adjust isocenter while fitting in
X direction
Y direction
Z direction
Fit Collimator to Target
Field geometry of 01 possibly causes collision.
Field geometry of 02 possibly causes collision.
To Optimization
Close
15cm X setting

Collimator Angle

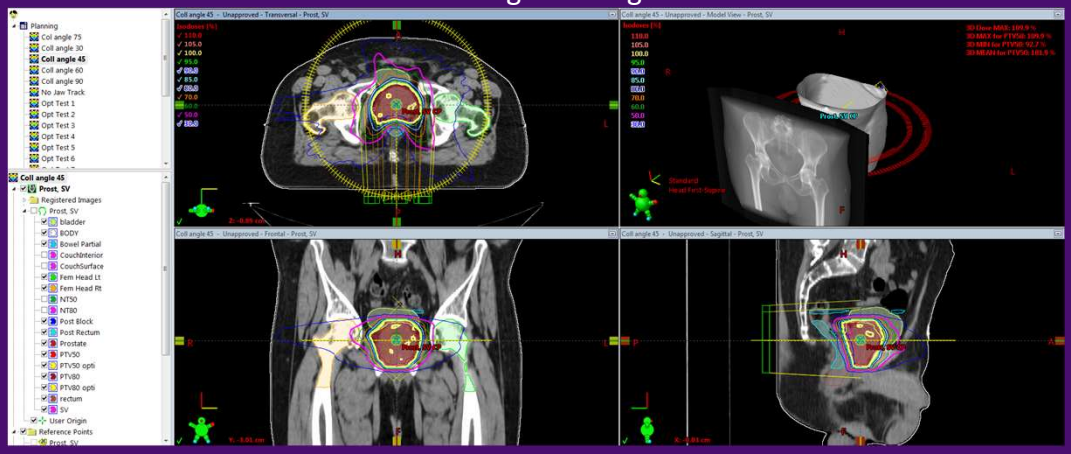
Coll Angle 15 Degrees



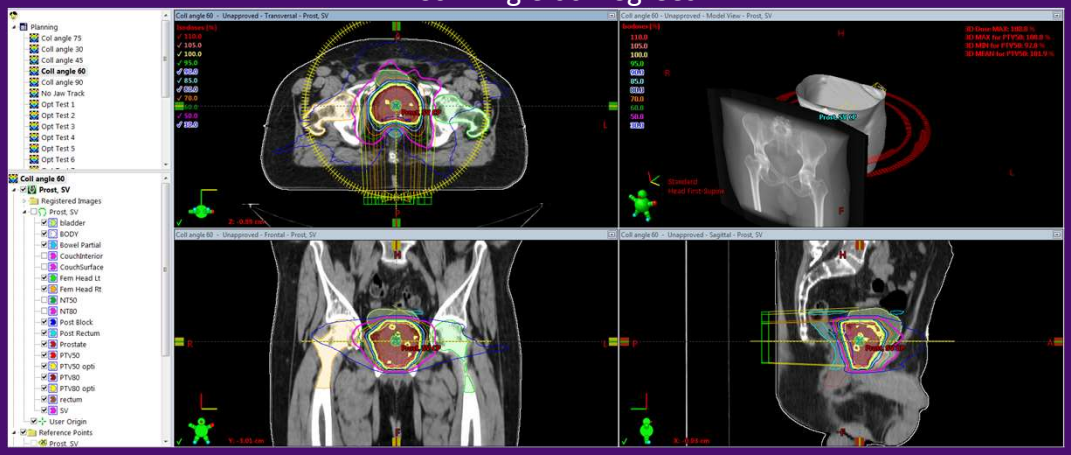
Coll Angle 30 Degrees



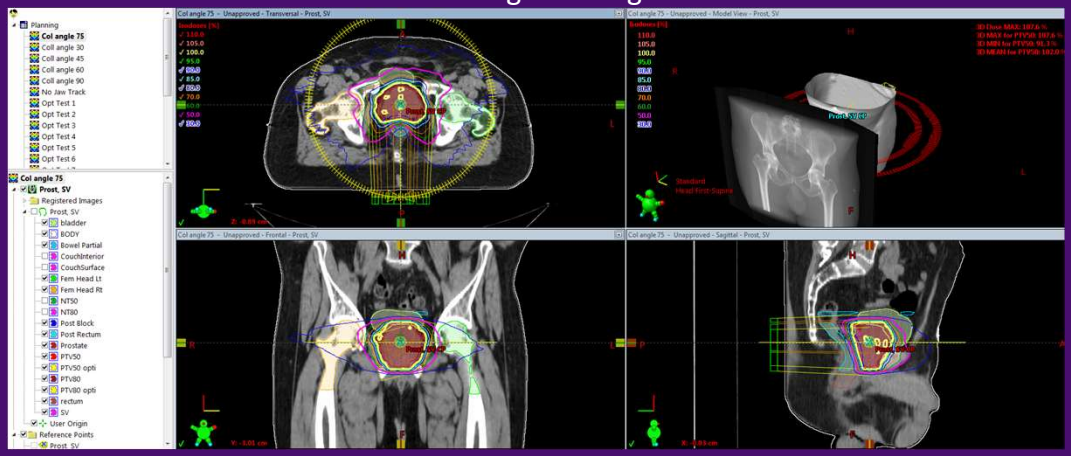
Coll Angle 45 Degrees



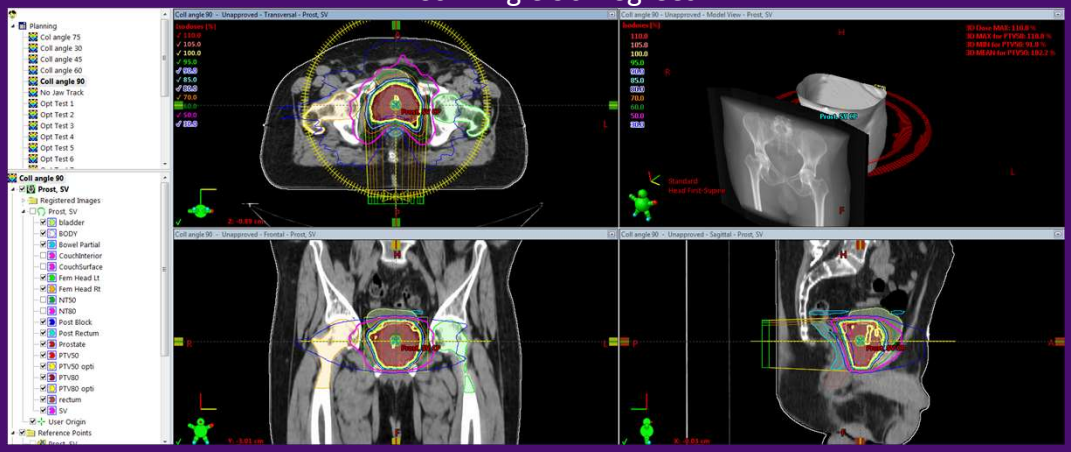
Coll Angle 60 Degrees

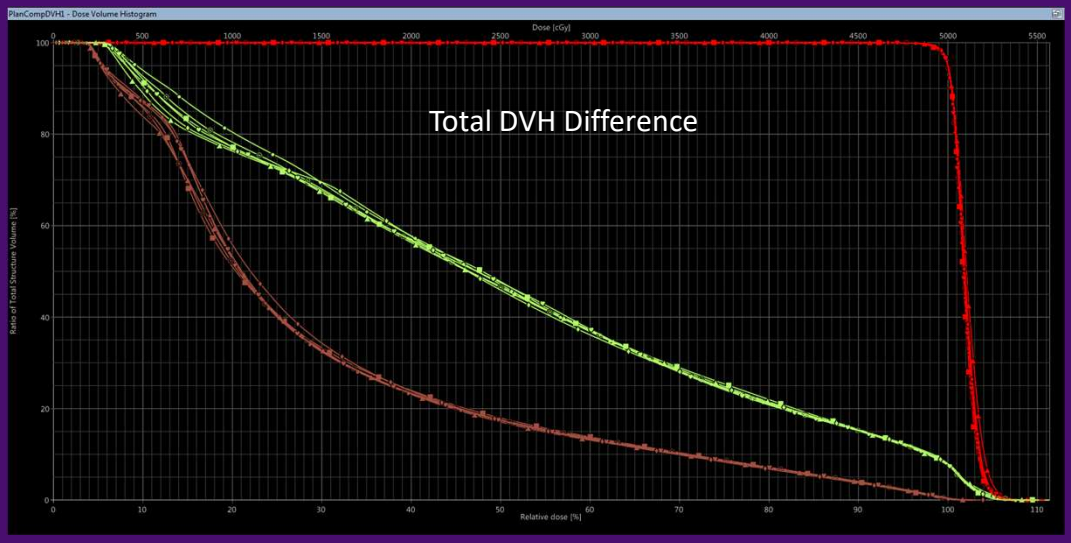


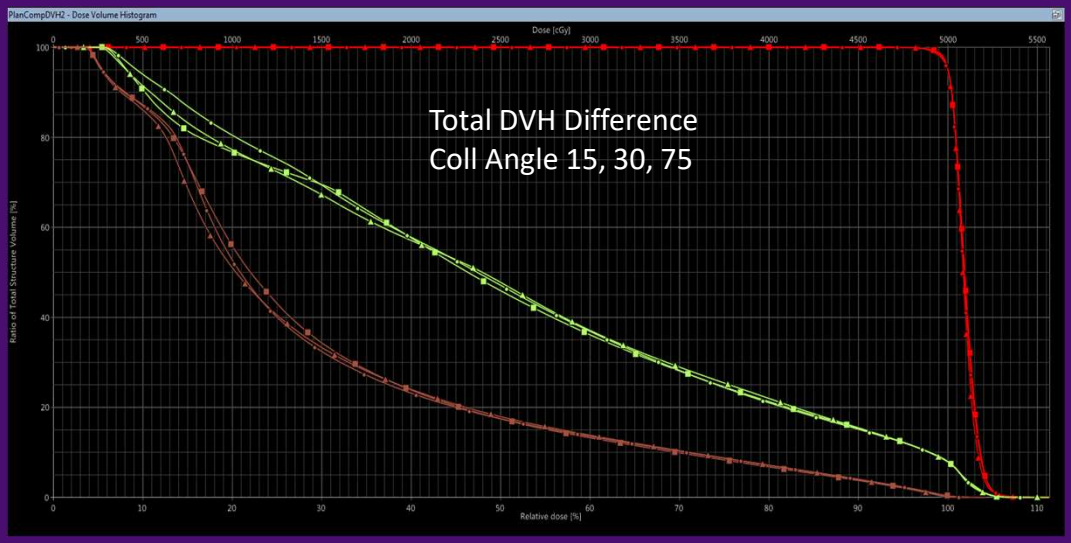
Coll Angle 75 Degrees



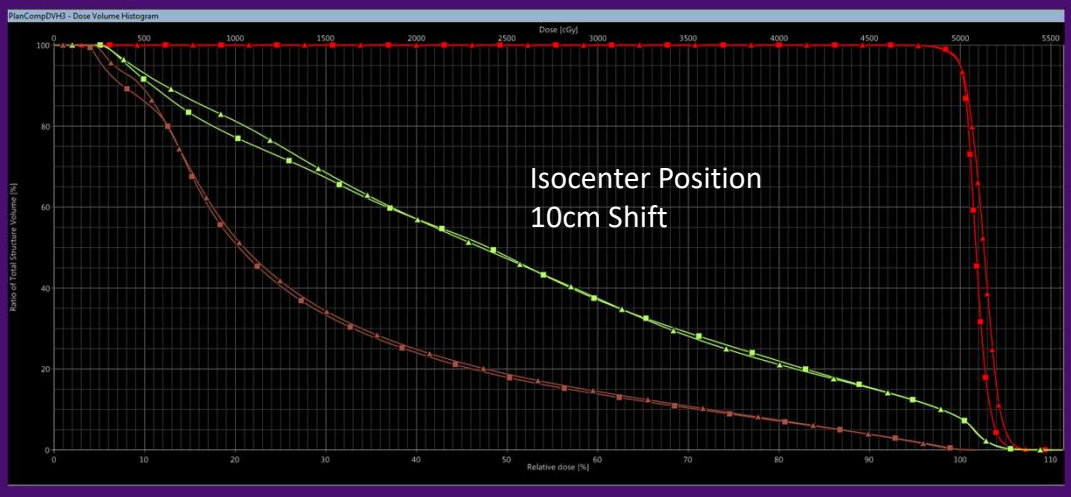
Coll Angle 90 Degrees



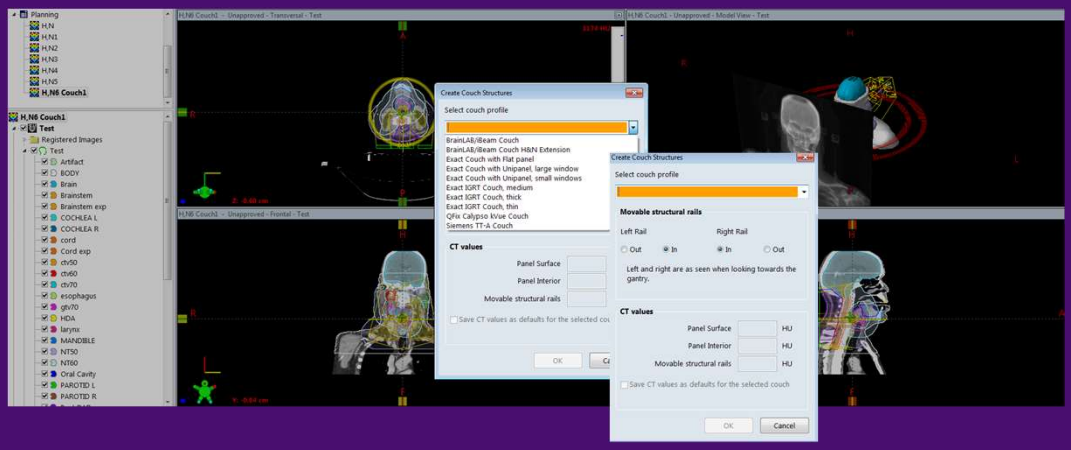

PlanCompDVH1 - Dose Volume Histogram
Dose [cGy]
Ratio of Total Structure Volume [%]
Relative dose [%]
Total DVH Difference


PlanCompDVH2 - Dose Volume Histogram
Dose [cGy]
Ratio of Total Structure Volume [%]
Relative dose [%]
Total DVH Difference
Coll Angle 15, 30, 75

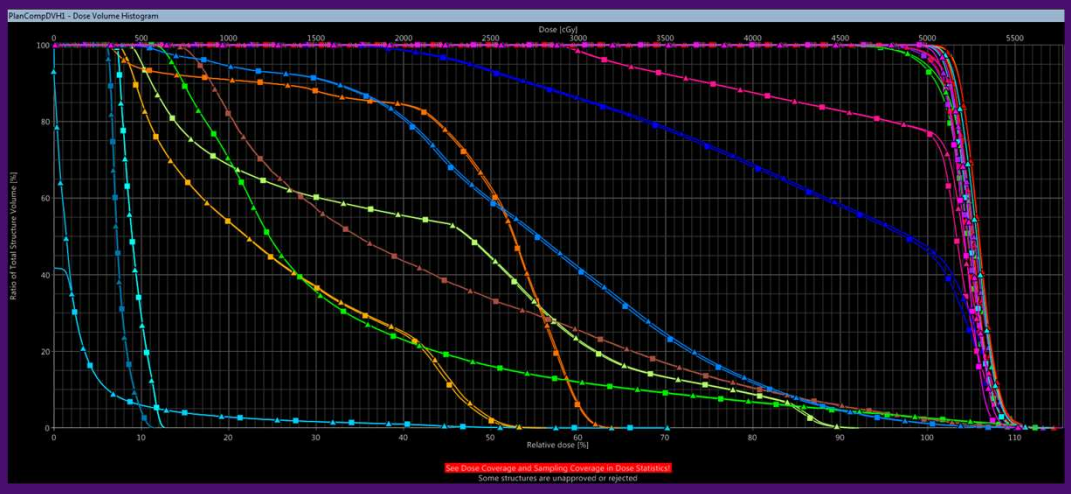
Additional Factors

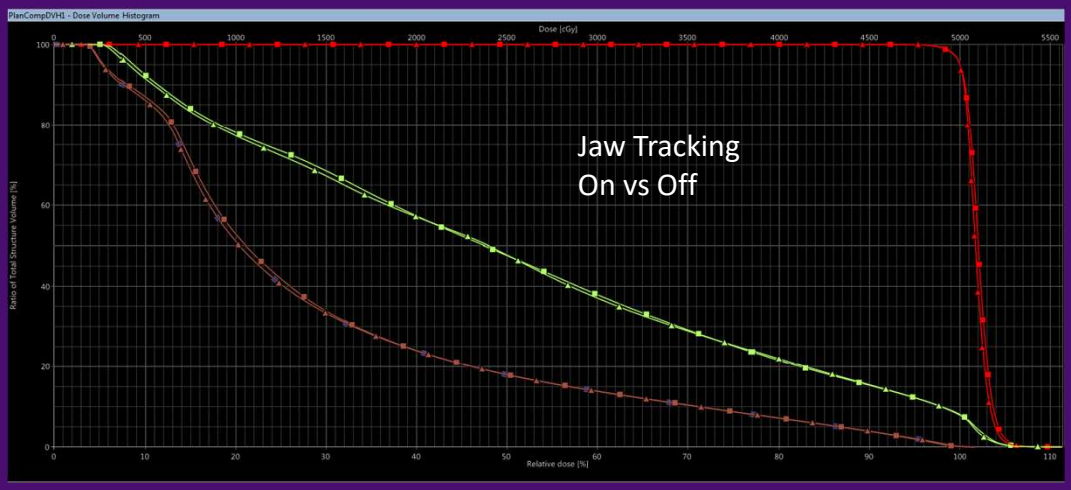


Couch



Couch, H,N





Note of Interest:

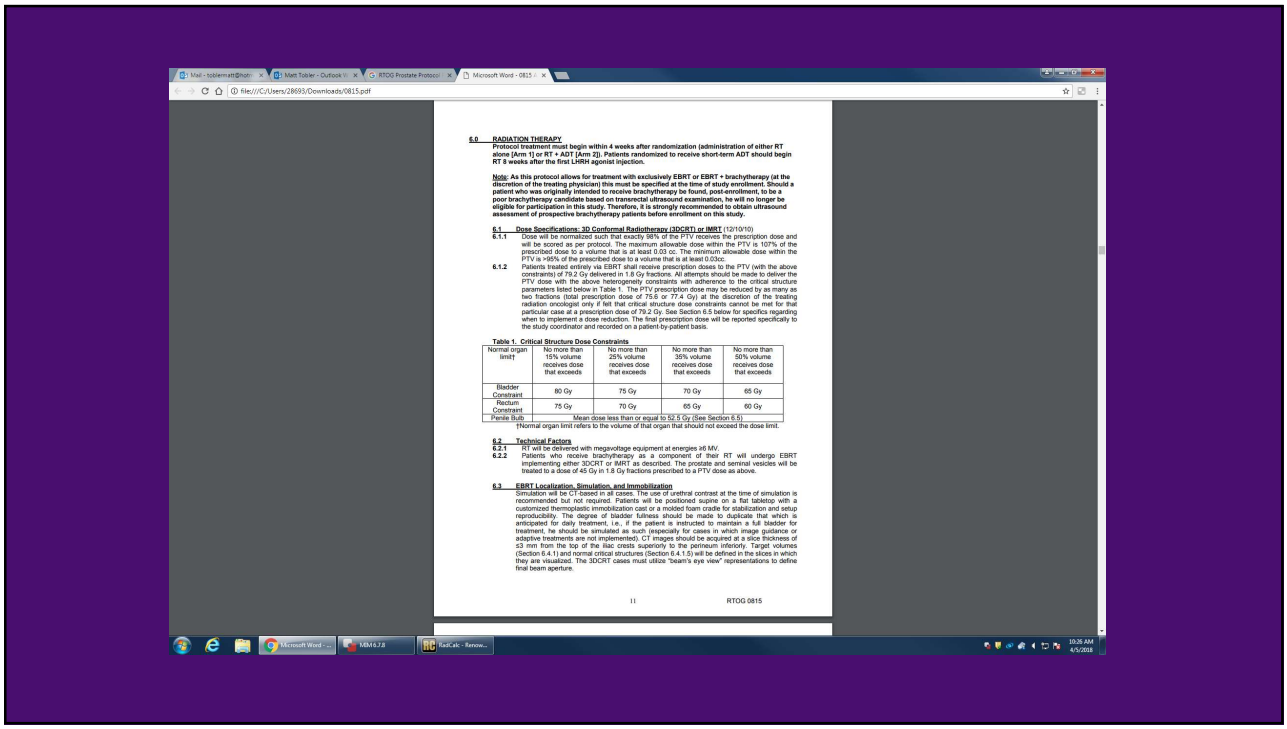
Note of Interest:
We haven't actually even started running our plan yet!

Optimization – The 'Real' Conversation

Optimization – 4 types

Optimization – 4 types

1) Minimal Constraint



6.0 RADIATION THERAPY
Protocol treatment must begin within 4 weeks after randomization (administration of either RT alone [Arm 1] or RT + ADT [Arm 2]). Patients randomized to receive short-term ADT should begin RT 8 weeks after the first LHRH agonist injection.

Note: As this protocol allows for treatment with exclusively EBRT or EBRT + brachytherapy (at the discretion of the treating physician) this must be specified at the time of study enrollment. Should a patient who was originally intended to receive brachytherapy be found, post-enrollment, to be a poor brachytherapy candidate based on transrectal ultrasound examination, he will no longer be eligible for participation in this study. Therefore, it is strongly recommended to obtain ultrasound assessment of prospective brachytherapy patients before enrollment on this study.

6.1 Dose Specifications: 3D Conformal Radiotherapy (3DCRT) or IMRT (12/10/10)

6.1.1 Dose will be normalized such that exactly 98% of the PTV receives the prescription dose and will be scored as per protocol. The maximum allowable dose within the PTV is 107% of the prescribed dose to a volume that is at least 0.03 cc. The minimum allowable dose within the PTV is >95% of the prescribed dose to a volume that is at least 0.03cc.

6.1.2 Patients treated entirely via EBRT shall receive prescription doses to the PTV (with the above constraints) of 79.2 Gy delivered in 1.8 Gy fractions. All attempts should be made to deliver the PTV dose with the above heterogeneity constraints with adherence to the critical structure parameters listed below in Table 1. The PTV prescription dose may be reduced by as many as two fractions (total prescription dose of 75.6 or 77.4 Gy) at the discretion of the treating radiation oncologist only if felt that critical structure dose constraints cannot be met for that particular case at a prescription dose of 79.2 Gy. See Section 6.5 below for specifics regarding when to implement a dose reduction. The final prescription dose will be reported specifically to the study coordinator and recorded on a patient-by-patient basis.

Table 1. Critical Structure Dose Constraints

Normal organ limit†	No more than 15% volume receives dose that exceeds	No more than 25% volume receives dose that exceeds	No more than 35% volume receives dose that exceeds	No more than 50% volume receives dose that exceeds
Bladder Constraint	80 Gy	75 Gy	70 Gy	65 Gy
Rectum Constraint	75 Gy	70 Gy	65 Gy	60 Gy
Penile Bulb	Mean dose less than or equal to 52.5 Gy (See Section 6.5)			

†Normal organ limit refers to the volume of that organ that should not exceed the dose limit.

6.2 Technical Factors

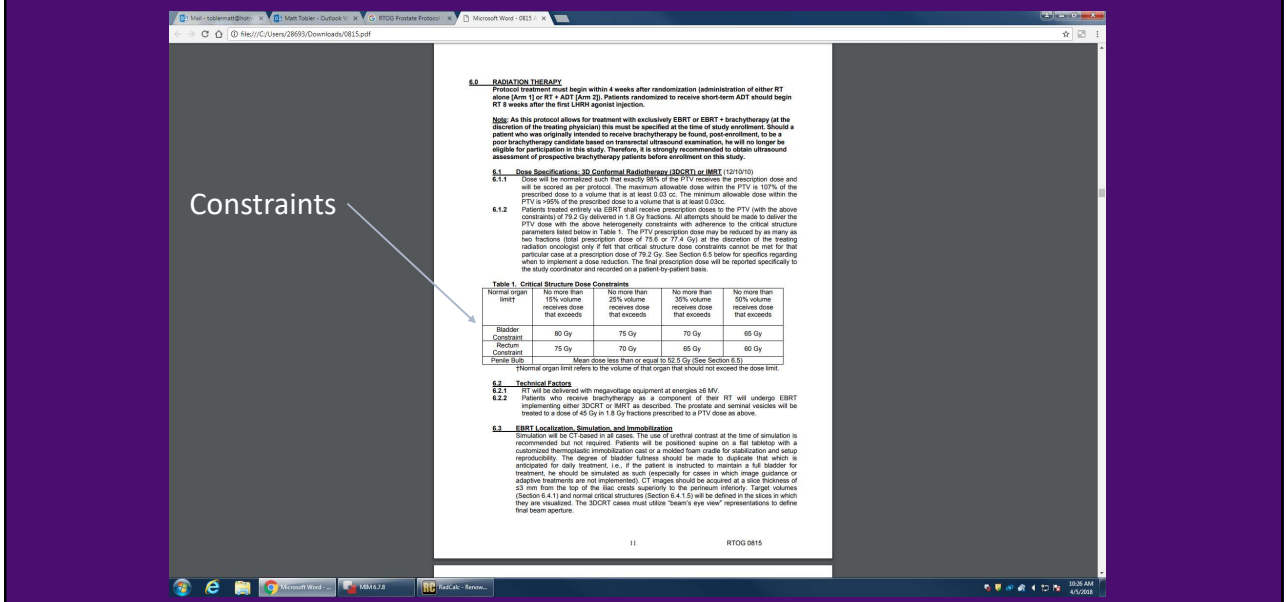
6.2.1 RT will be delivered with megavoltage equipment at energies ≥6 MV.

6.2.2 Patients who receive brachytherapy as a component of their RT will undergo EBRT implementing either 3DCRT or IMRT as described. The prostate and seminal vesicles will be treated to a dose of 45 Gy in 1.8 Gy fractions prescribed to a PTV dose as above.

6.3 EBRT Localization, Simulation, and Immobilization

Simulation will be CT-based in all cases. The use of urethral contrast at the time of simulation is recommended but not required. Patients will be positioned supine on a flat tabletop with a customized thermoplastic immobilization cast or a molded foam cradle for stabilization and setup reproducibility. The degree of bladder fullness should be made to duplicate that which is anticipated for daily treatment, i.e., if the patient is instructed to maintain a full bladder for treatment, he should be simulated as such (especially for cases in which image guidance or adaptive treatments are not implemented). CT images should be acquired at a slice thickness of ≤3 mm from the top of the iliac crests superiorly to the perineum inferiorly. Target volumes (Section 6.4.1) and normal critical structures (Section 6.4.1.5) will be defined in the slices in which they are visualized. The 3DCRT cases must utilize "beam's eye view" representations to define final beam aperture.

11 RTOG 0815



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Note: As this protocol allows for treatment with exclusively EBRT or EBRT + brachytherapy (at the discretion of the treating physician) this must be specified at the time of study enrollment. Should a patient who was originally intended to receive brachytherapy be found, post-enrollment, to be a poor brachytherapy candidate based on transrectal ultrasound examination, he will no longer be eligible for participation in this study. Therefore, it is strongly recommended to obtain ultrasound assessment of prospective brachytherapy patients before enrollment on this study.

6.1 Dose Specifications: 3D Conformal Radiotherapy (3DCRT) or IMRT (12/10/10)

6.1.1 Dose will be normalized such that exactly 98% of the PTV receives the prescription dose and will be scored as per protocol. The maximum allowable dose within the PTV is 107% of the prescribed dose to a volume that is at least 0.03 cc. The minimum allowable dose within the PTV is >95% of the prescribed dose to a volume that is at least 0.03cc.

6.1.2 Patients treated entirely via EBRT shall receive prescription doses to the PTV (with the above constraints) of 79.2 Gy delivered in 1.8 Gy fractions. All attempts should be made to deliver the PTV dose with the above heterogeneity constraints with adherence to the critical structure parameters listed below in Table 1. The PTV prescription dose may be reduced by as many as two fractions (total prescription dose of 75.6 or 77.4 Gy) at the discretion of the treating radiation oncologist only if felt that critical structure dose constraints cannot be met for that particular case at a prescription dose of 79.2 Gy. See Section 6.5 below for specifics regarding when to implement a dose reduction. The final prescription dose will be reported specifically to the study coordinator and recorded on a patient-by-patient basis.

Table 1. Critical Structure Dose Constraints

Normal organ limit†	No more than 15% volume receives dose that exceeds	No more than 25% volume receives dose that exceeds	No more than 35% volume receives dose that exceeds	No more than 50% volume receives dose that exceeds
Bladder Constraint	80 Gy	75 Gy	70 Gy	65 Gy
Rectum Constraint	75 Gy	70 Gy	65 Gy	60 Gy
Penile Bulb	Mean dose less than or equal to 52.5 Gy (See Section 6.5)			

†Normal organ limit refers to the volume of that organ that should not exceed the dose limit.

6.2 Technical Factors

6.2.1 RT will be delivered with megavoltage equipment at energies ≥6 MV.

6.2.2 Patients who receive brachytherapy as a component of their RT will undergo EBRT implementing either 3DCRT or IMRT as described. The prostate and seminal vesicles will be treated to a dose of 45 Gy in 1.8 Gy fractions prescribed to a PTV dose as above.

6.3 EBRT Localization, Simulation, and Immobilization

Simulation will be CT-based in all cases. The use of urethral contrast at the time of simulation is recommended but not required. Patients will be positioned supine on a flat tabletop with a customized thermoplastic immobilization cast or a molded foam cradle for stabilization and setup reproducibility. The degree of bladder fullness should be made to duplicate that which is anticipated for daily treatment, i.e., if the patient is instructed to maintain a full bladder for treatment, he should be simulated as such (especially for cases in which image guidance or adaptive treatments are not implemented). CT images should be acquired at a slice thickness of ≤3 mm from the top of the iliac crests superiorly to the perineum inferiorly. Target volumes (Section 6.4.1) and normal critical structures (Section 6.4.1.5) will be defined in the slices in which they are visualized. The 3DCRT cases must utilize "beam's eye view" representations to define final beam aperture.

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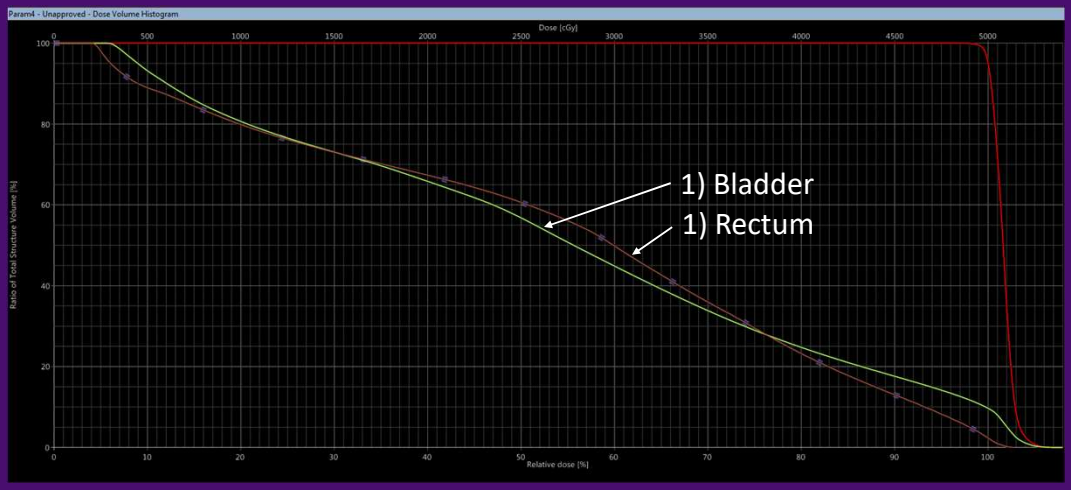
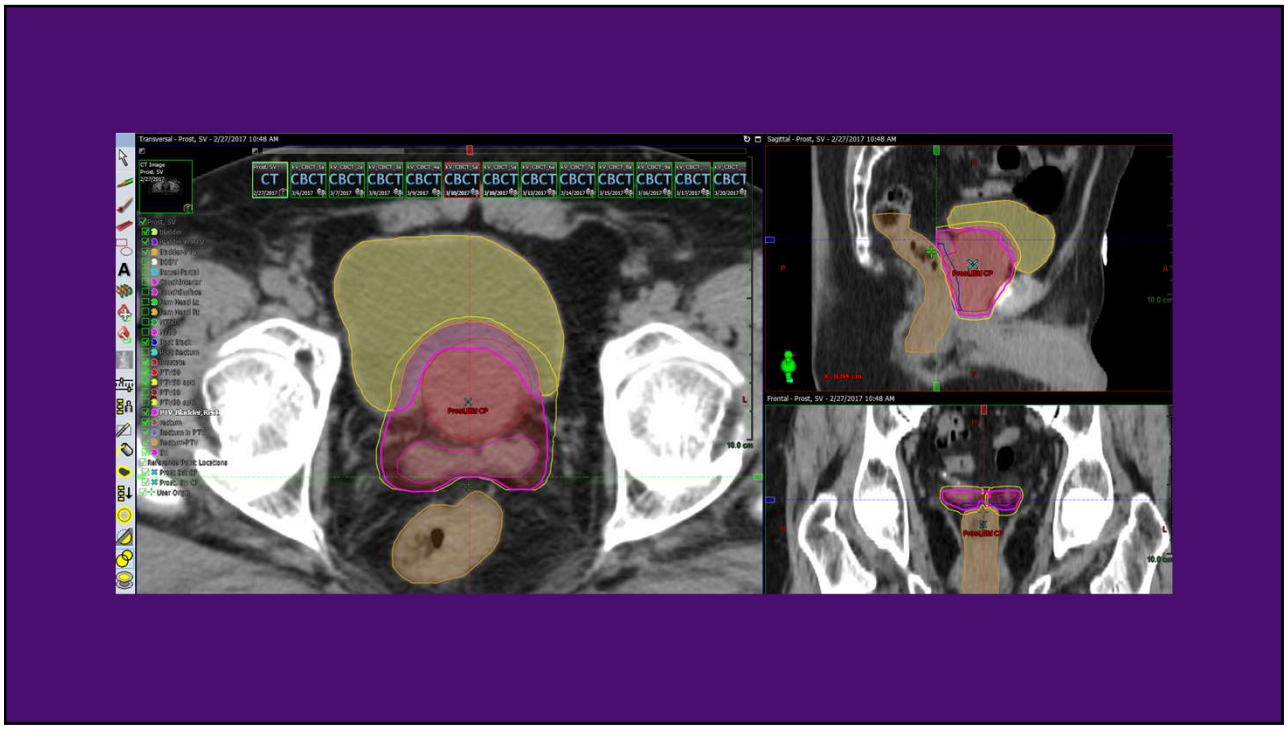


Optimization – 4 types

1) Minimal Constraint
2) Brute Force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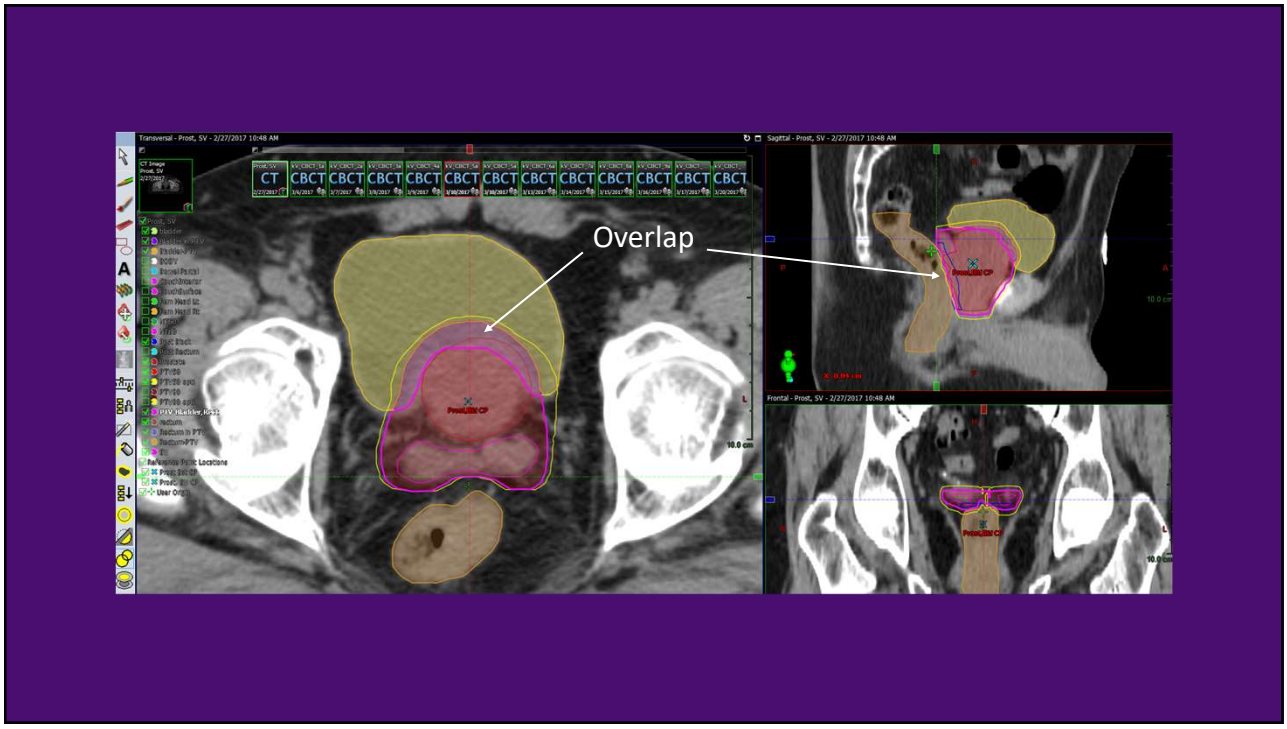
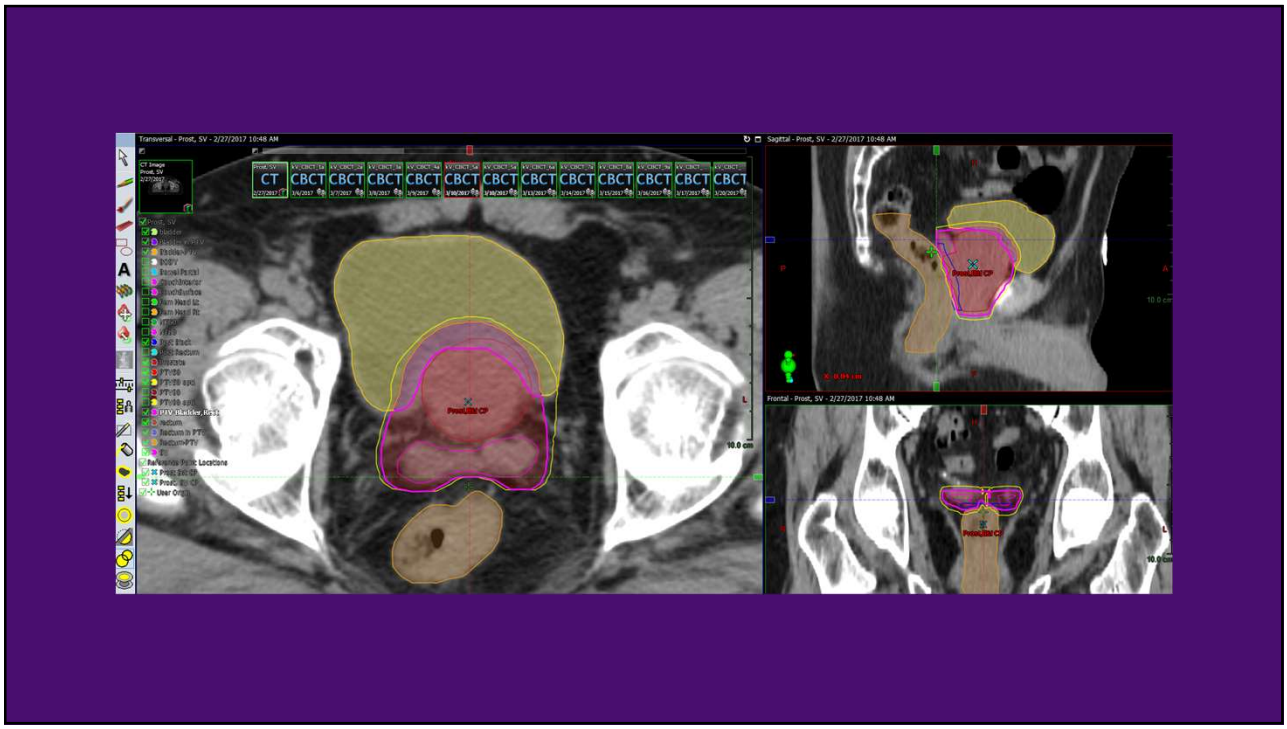
Sagittal - Prost, SV - 2/27/2017 10:48 AM
Frontal - Prost, SV - 2/27/2017 10:48 AM


Overlap
Transversal - Prost, SV - 2/27/2017 10:48 AM
Sagittal - Prost, SV - 2/27/2017 10:48 AM
Frontal - Prost, SV - 2/27/2017 10:48 AM

Optimization – 4 types

1) Minimal Constraint
2) Brute Force
3) Single Pixel Ownership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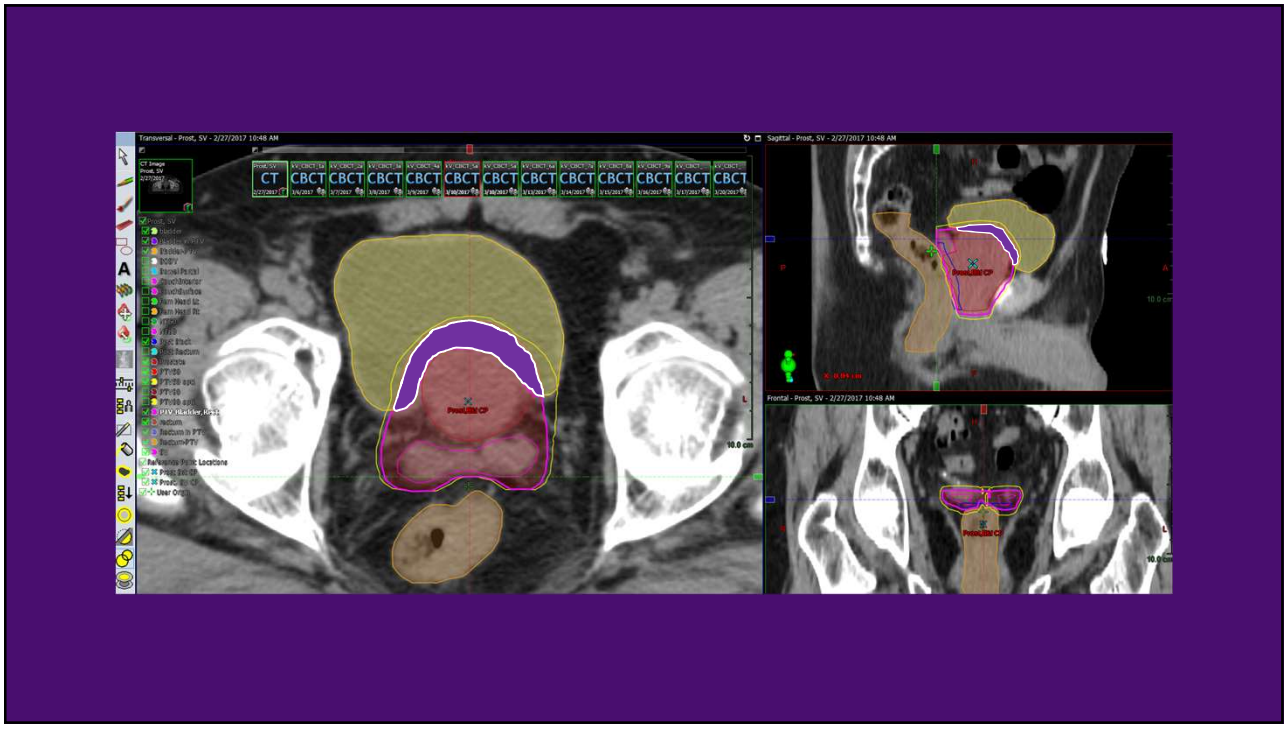
Frontal - Prost, SV - 2/27/2017 10:48 AM
CT
CBCT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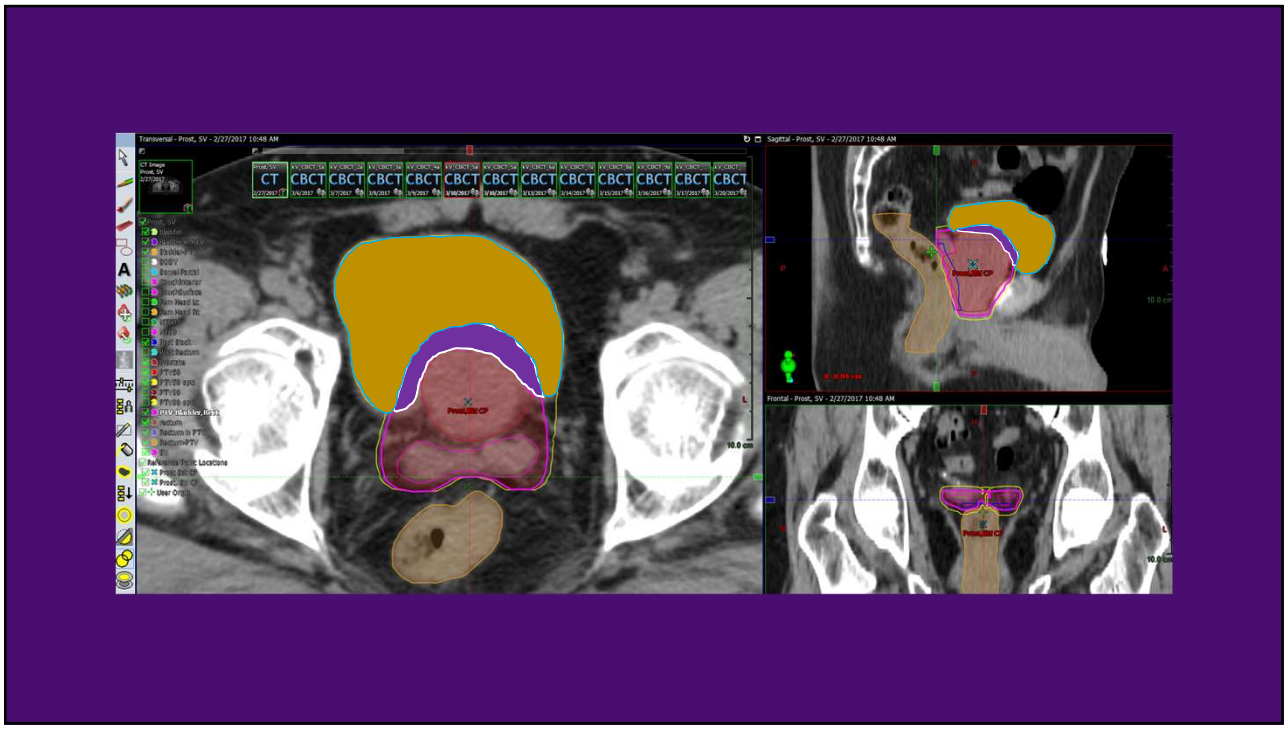
CT
CBCT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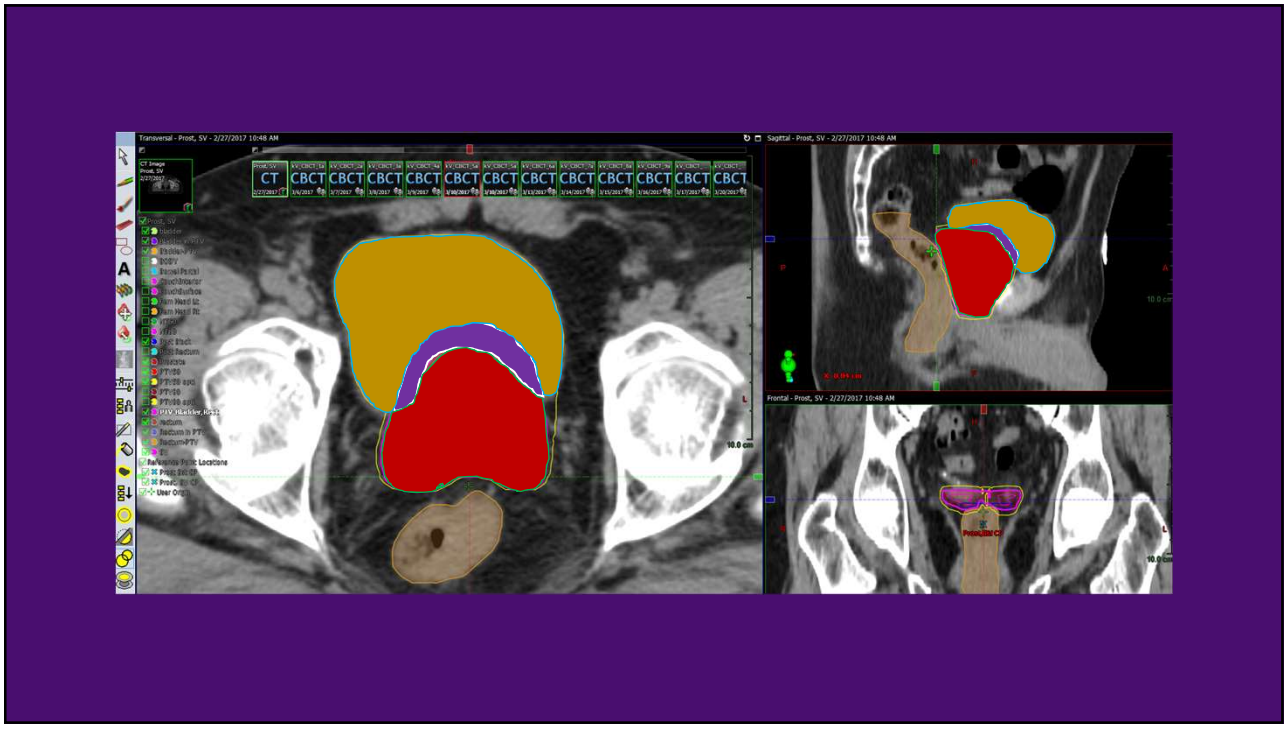
Frontal - Prost, SV - 2/27/2017 10:48 AM
CT
CBCT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Sagittal - Prost, SV - 2/27/2017 10:48 AM
Frontal - Prost, SV - 2/27/2017 10:48 AM
CT
CBCT

Structure List Brute Force
Prostate Overlaps
- Bladder
- Rectum
- PTV

Structure List Single Pixel
Prostate Single Owner
- Bladder
- Bladder in PTV
- Bladder – PTV
- Rectum in PTV
- Rectum – PTV
- PTV
- PTV - Bladder

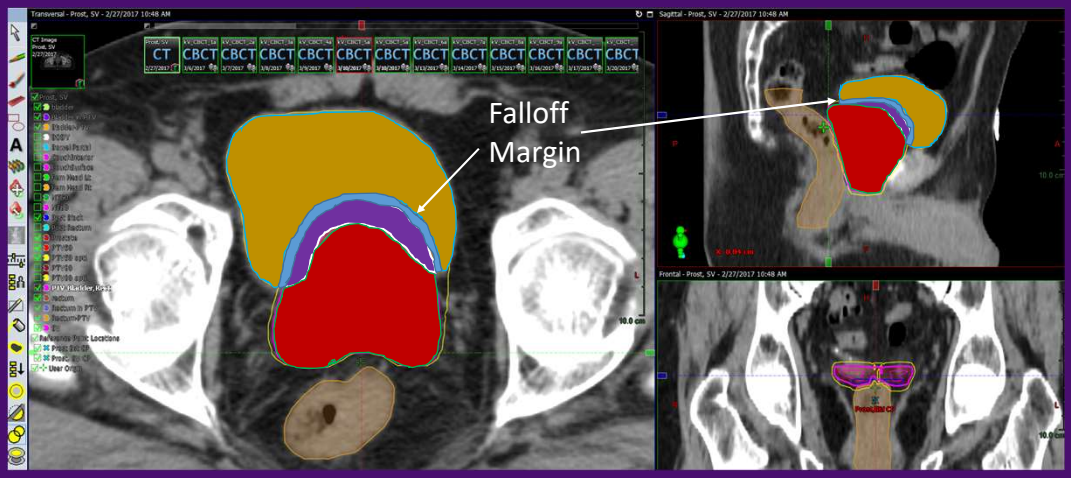
Structure List Brute Force
H+N Overlaps
- Parotid Rt
- Parotid Lt
- Oral Cavity
- Mandible
- Larynx
- Esophagus
- Sub Mandib Rt
- Submandib Lt
- PTV

Structure List Brute Force
H+N Overlaps
- Parotid Rt (3 structures)
- Parotid Lt (3)
- Oral Cavity (3)
- Mandible (3)
- Larynx (3)
- Esophagus (3)
- Sub Mandib Rt (3)
- Submandib Lt (3)
- PTV (2)

→ 9 Structures Become 26 Structures

Optimization – 4 types

1) Minimal Constraint
2) Brute Force
3) Single Pixel Ownership
4) Modified Single Pixel



Normalization vs Optimization

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