

Elekta MOSAIQ and Philips Pinnacle

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Conflicts
NONE

Professional Affiliations

Member, AAPM Subcommittee on Training and Practice of
Medical Dosimetry

Member, AAPM Working Group for Prevention of Errors

Member, AAPM TG-275 – Strategies for Effective Physics
Plan and Chart Review in Radiation Therapy

Learning Objectives

The participant will be able to:

- Apply plan/chart methodology using Pinnacle/MOSAIQ configuration.
- Identify three high-risk failure modes in plan/chart checks.
- Integrate recommendations of TG-275 in the clinic.

Snap Shot of East Orange VA Radiation Oncology

Radiation Oncologists:

- Chief of Service
- 1 FT + 3 PT

Medical Physicists:

- Chief (Agency Coverage)
- 1 FT Staff (vacant)

Medical Dosimetrists:

- 2 CMDs (1 vacant)

Radiation Therapists:

- Chief
- 1 FT Clinical Lead + 6 RTTs

Equipment:

- Elekta Infinity, Siemens, Philips Big Bore CT, Elekta/Nucletron HDR, Elekta seedSelectron, Varian Calypso, Philips TPS, Oncentra Brachy, Oncentra Prostate, MimVista, MOSAIQ, Monaco (nonclinical)



Nursing Staff:

- 1 NP + 2 FT RNs
- 1 Health Tech
- 3 Nurse Navigators

Other:

- 1 PT Clinical Psychologist
- 1 PT Social Worker
- 1 PT Dietitian
- 1 FT Administrative Officer
- 1 FT Receptionist

Patient Load:

- 200 Consults/year
- 175 RT Patients/year
- 60% IMRT
- SBRT/SRS/HDR/Prostate LDR

Challenges We Face . . .

STAFFING

Radiation Oncologists:

- Chief of Service (**20% clinical**)
- **1 FT + 3 PT**

Medical Physicists:

- Chief (**Agency Coverage**)
- 1 FT Staff (**vacant**)

Medical Dosimetrists:

- 2 CMDs (**1 vacant**)

EQUIPMENT

- Elekta Infinity
- Siemens Impression Plus
- Philips Big Bore CT
- Elekta/Nucletron HDR
- Elekta seedSelectron
- Varian Calypso
- **Philips Pinnacle TPS**
- Oncentra Brachy
- Oncentra Prostate
- **MimVista**
- **Elekta MOSAIQ**
- Elekta Monaco (not clinical)

Challenges We Face . . .

Pinnacle —————→ **MOSAIQ**

In Pinnacle:

Approx 40 clicks to export DICOM data and Plan PDF and import into eScan

3D:

Approx 20 clicks to export into RadCalc and export report to eScan

IMRT/VMAT:

Approx 40 clicks to prep QA plan on phantom and export to QA folder

In MOSAIQ:

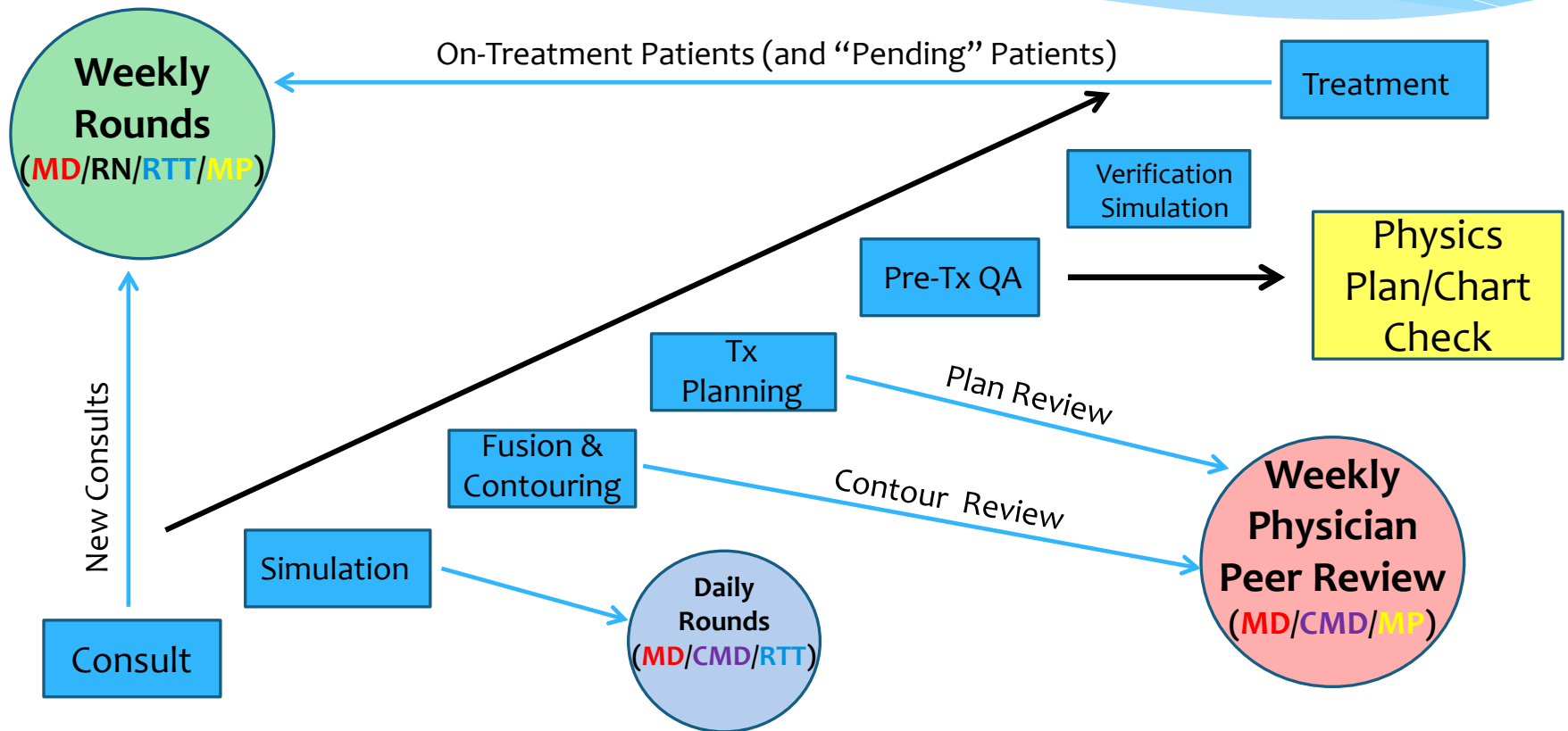
Approx 20 clicks to RTP import, complete Site setup, associate images & complete & approve fields

Grand Total: 80-100 clicks (or steps)

Improvements...

- **Standardization** (Multiple MDs)
 - “**Standard patients**” in MOSAIQ
 - Standard Objective/Constraint Spreadsheets
- **Checklists**
 - **MOSAIQ Assessments**
 - Planner
 - Physics Plan/Chart Check
- **Physician Peer Review** (Weekly)
 - Contour Review (**before planning is completed**)
 - Plan Review (**prior to verification simulation/treatment**)
- **Mode of Communication**
 - MOSAIQ QCLs
 - iQScripts (**Evolving**)

Department Review Process



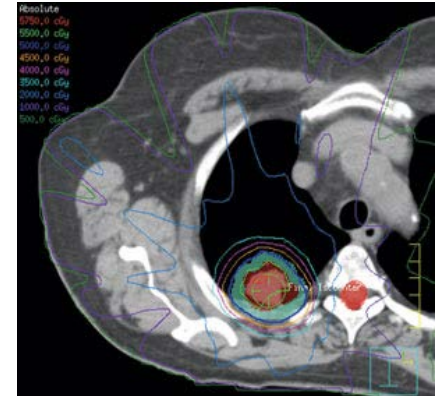
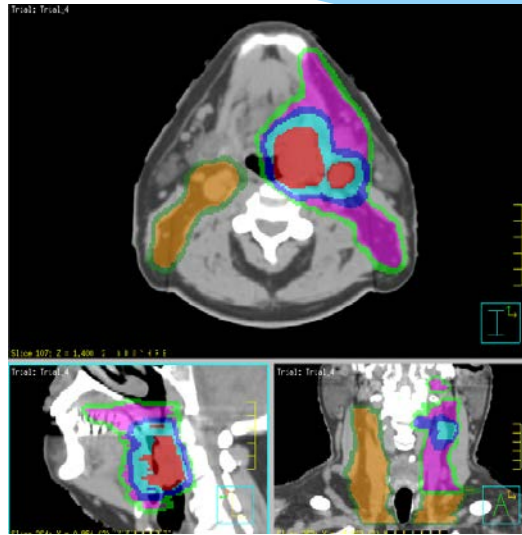
Physics Plan Review Pinnacle/MOSAIQ

Targets and Expansions

Isodoses and Target Coverage

MOSAIQ Prescription (adopted TG-263)

Rad Rx: PTV_6996: 6996 cGy / 33 fxs
Dose Spec: Calc Pt **97%**
Rad Rx: PTV_5940cGy per Plan
Rad Rx: PTV_5412cGy per Plan



GTV = **left tonsil slight extension left glossotonsillar sulcus and left level II-III LN**

CTV_6996 = GTV + **5mm** modified off muscle, air, and bone

CTV_5940 = GTV P + **8 margin covering soft palate, hemihard palate, retromolar trigone, parapharyngeal space, and valleculae + GTV LN IB, II, III modified off muscle, bone, and air**

CTV_5412 = **L LN level IV, V, R LN II-IV**

PTV_6996 = CTV_6996 + **3mm**: 6996cGy delivered to > 95% volume; minimum dose > 93%; 0.1cc volume < 107%

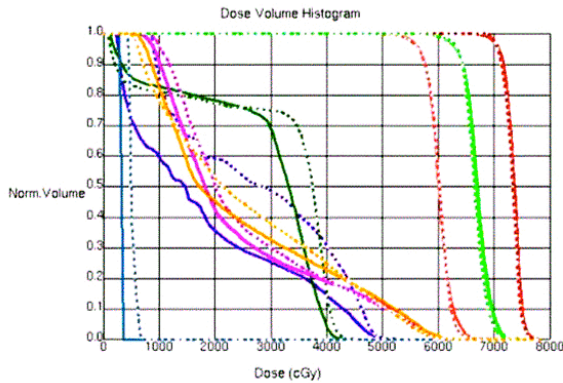
PTV_5940 = CTV_5940 + **3mm**: 5940cGy delivered to > 95% volume; minimum dose > 93%

PTV_5412 = CTV_5412 + **3mm**: 5412cGy delivered to > 95% volume; minimum dose > 93%

Physics Plan Review

Pinnacle/MOSAIQ

DVH and Spreadsheet



OAR's

Spinal Cord (exp 5mm)	Max Dose (0.1cc)	5000	Max	4559
Spinal Cord (exp 3mm)	Max Dose (0.1cc)	4500	Max	4385
Spinal Cord	Max Dose	4500	Max	4308
Brain Stem (exp 5mm)	Max Dose (0.1cc)	5400	Max	4395
Brain Stem	Max Dose	5400	Max	4141
Mandible	Max Dose (0.1cc)	7000	Max	6952
Eyes (Rt & Lt)	Max Dose	4500	Max	258 & 320
Lens (Rt & Lt)	Max Dose	800	Max	170 & 205
Optic Nerve (Rt & Lt)	Max Dose	5400	Max	305 & 380
Optic Chiasm	Max Dose	5400	Max	358
Esophagus	Mean Dose	3400	Mean	2776
Cochlea (Rt & Lt)	Max Dose	4500	Max	1976 & 3851
Rt Parotid	Mean Dose DVH	2600	Mean	2543
Lt Parotid	Mean Dose	2600	Mean	2567
Larynx minus PTVs	Mean Dose	3000	Mean	3055 *
Oral Cavity minus PTVs	Mean Dose	3000	Mean	3966 *

Objectives and Constraints				Plan Results		
ROI	Type	Prescription	Composite Goal (cGy)		Composite	
PTV_6996	ctv1 + 3mm	Rx (cGy)	Total Dose (cGy)	Vol (cc)	Vol of PTV receiving script dose	%
		6996	6996	136.1	129.5	95.2%
PTV_5940	ctv2 + 3mm	RX (cGy)	Total Dose (cGy)	Vol (cc)	Vol of PTV receiving script dose	%
		5940	5940	291.2	285.5	98.0%
PTV_5412	ctv3 + 3mm	RX (cGy)	Total Dose (cGy)	Vol (cc)	Vol of PTV receiving script dose	%
		5412	5412	350.6	338.7	96.6%
CTV_6996			Vol (cc)	coverage	Vol of CTV receiving script dose	%
			87.6	100%	87.3	99.7% *
Min Dose to PTV_6996	99.9% volume		cGy	coverage	Dose(cGy) delivered to 99.9% vol	%
			6506	>93%	6747.0	96.4%

Physics Plan Review

Pinnacle/MOSAIQ

MOSAIQ Assessment: *“Second Treatment Plan Review”*

- Correct Patient and Site
- Plan agrees with script
- Imaging Correct
- Rad Rx approved by MD
- Tx Planning parameters correct
- Bolus & Beam modifier correct
- ROIs correct for Site
- Graphical Isodoses = Intent
- DVH appropriate for site
- DRRs associated to fields
- Independent Calc within +/- 5%
- Site Setup Accurate
- EMR field parameters match plan
- Pt specific QA within specs
- Plan signed by Planner
- Plan signed by MD
- Plan signed by Physicist
- Special Physics Consult Complete
- In Vivo Dosimetry form ready
- Charges Captured Correctly
- 2nd Tx Plan Review Initials
- 2nd Tx Plan Review Comments

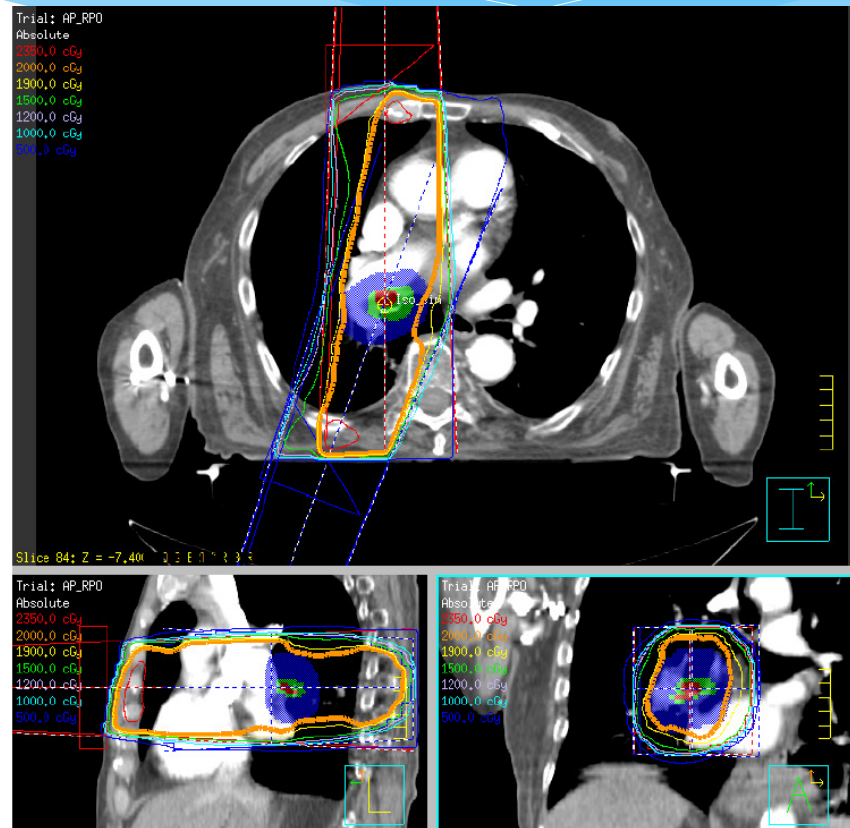
Physics Plan/Chart Review Pinnacle/MOSAIQ

**Real Life Examples found
during Physics Plan/Chart
Reviews**

All in ONE WEEK!!!!

Case #1

82 year old male with T1NoMo SCC of the Right Bronchus (Stage 1A) planned to receive definitive radiation with a maximum of 2000cGy/10 fractions using a 3D plan then switch to an IMRT plan for a total of 6400cGy/32 fractions.



Case #1

What Happened?

- MD approves plan on Pinnacle
- Dosimetrist transfers plan to MOSAIQ
- **During dosimetrist plan/chart review, dosimetrist notices no MLC on AP field**
- In Pinnacle, Dosimetrist invokes MLC on AP field
- Exports plan from Pinnacle to MOSAIQ
- Physics Plan/Chart Review

	AP MU (wedge/open)	RPO MU (wedge/open)
Plan	167.5 (49.24/118.26)	181.5 (73.04/108.46)
MOSAIQ	167.5 (49.24/118.26)	185.2 (74.53/110.67)

+2%

Dosimetrist imported only AP field & did not check RPO field.

Case #1

TG-275: Failure Modes/Causes

High Risk Failure Modes for initial plan/chart review

FM#	Process Step	Failure Mode	Cause	RPN	S	O	D
43	Tx Plan	Incorrect Field Parameters	MLC not invoked in one field; wrong MU	105.1	5.6	4.4	4.3

EBRT Initial plan/chart review checks from AAPM all-member survey

Physics Check Item	Corresponding FM	Highest RPN	Use Freq
TP-Q6-8: Beam modifiers (e.g. wedges, electron and photon blocks , tray, etc)	58,88,105,111	95.2	92%
TP-Q6-13: Field Aperture	41, 43 ,58,70,72	105.2	96%
TP-Q7a-10: MU	37, 43 ,81,94	107.6	68%
TP-Q7a-15: Field Aperture	41, 43 ,94	105.2	56%

Case #2

81 year old male with Stage 4 carcinoma of the prostate metastatic to the bone. He was planned to receive palliative radiation with 2000cGy/5 fractions to two sites of the spine; T spine (4-9) and L spine (1-3). Each site uses AP/PA fields.



Case #2

What Happened?

- Setup notes and photos were exactly the same for both sites
- Longitudinal tolerance was too board

	Original	Modified	
		T Spine	L Spine
Setup Notes And Photos	<p>Pt HFS large black mat, wingboard, U-bar A-1,2 #1 blue cushions under head, 2 #5 blue wedge under elbows, #2 knee wedge and tattoos.</p> <p>NOTE: 2 ISO, LINE UP TO L2 TATTOOS THEN SHIFT TO T2 ISO. TT=L2 13.8 / T5 10CM Sep = L2 22.2 / T5 23cm</p>	<p>2 ISO LINE UP TO L2 TATTOOS THEN SHIFT TO T2 ISO. TT=10cm; Sep = 23cm</p> <p>Pt HFS large black mat, wingboard, U-bar A-1,2 #1 blue cushions under head, 2 #5 blue wedge under elbows, #2 knee wedge and tattoos.</p>	<p>TT=13.8; Sep = 22.2</p> <p>Pt HFS large black mat, wingboard, U-bar A-1,2 #1 blue cushions under head, 2 #5 blue wedge under elbows, #2 knee wedge and tattoos.</p>
Tolerance Table	Photon 3D (Long = 10cm)	Long (Long = 3cm)	Long (Long = 3cm)

Case #2

TG-275

High Risk Failure Modes for initial plan/chart review

FM#	Process Step	Failure Mode	Cause	RPN	S	O	D
24	Simulation	Wrong setup instructions	Therapists inattention to workflow; Setup photos	124.4	3.7	6.2	5.5

EBRT Initial plan/chart review checks from AAPM all-member survey

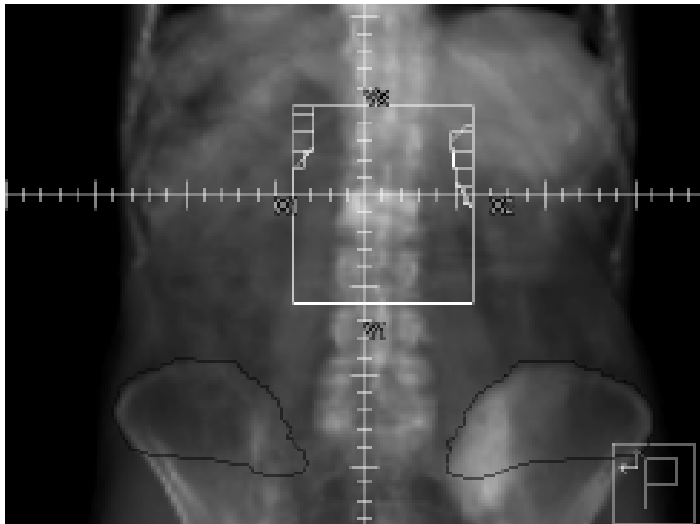
Physics Check Item	Corresponding FM	Highest RPN	Use Freq
Sim-Q1-5: Written or photographic documentation of patient positioning , immobilization and ancillary devices	24 ,33,47,63,78,80	124.4	70%
Sim-Q1-8: Patient setup and positioning	24 ,47,51,52	124.4	75%
Sim-Q1-9: Setup note	24 ,47,52	124.4	69%
TP-Q6-14: Tolerance Table	None	N/A	81%

Case #2

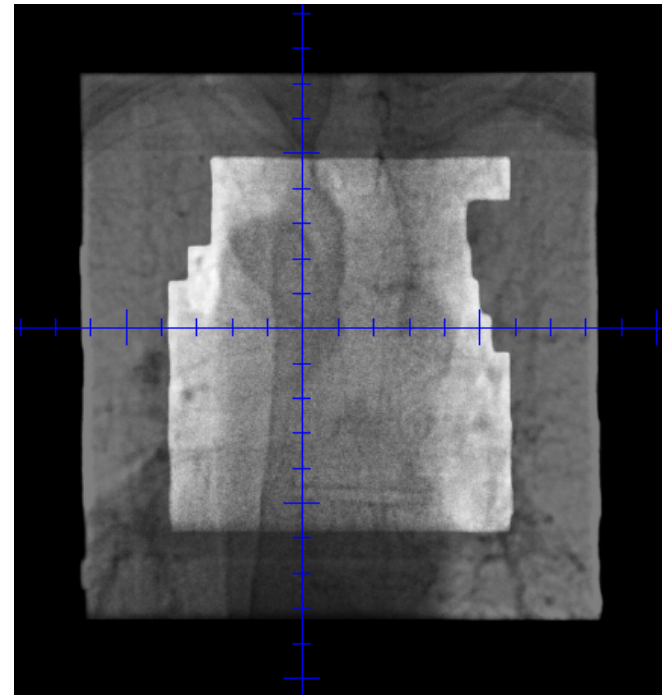
BUT ...

Failure Mode during pre-treatment imaging:

L-Spine DRR



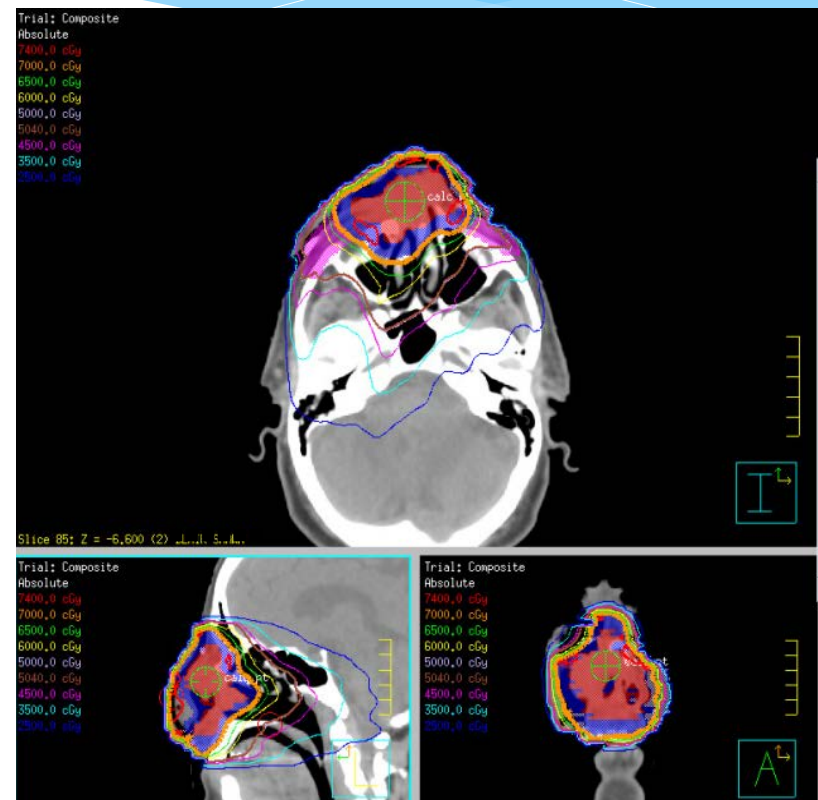
Pre-Treatment Image



Case #3

Composite Plan

63 year old male with nasal SCC status post nasal mass excision who now has a recurrence involving the entire nose and medial aspect of the right eye. The positive margin area (PTV1) was prescribed to 5600cGy/28 fractions and the adjacent probable area (PTV2) to 5040cGy/28 fractions using dose painting. A 1400cGy/7 fractions cone down would follow to PTV1 for a total dose of 7000cGy/35 fractions.



Case #3 (continued)

Physician Peer Review . . . Discussion . . . Patient “needs to start”
 Pre-Tx QA for Initial Plan . . . QA passed
 Physics Plan/Chart Review . . .

	Initial Plan (28 fx)		Cone Down Plan (7 fx)		Composite Plan	
	PTV1	PTV2	PTV1	PTV2	PTV1	PTV2
Prescription	5600	5040	1400	0	7000	5040
Plan	5600	≈4600	1400	≈350	7000	5040

	Initial Plan (31 fx)		Cone Down Plan (4 fx)		Composite Plan	
	PTV1	PTV2	PTV1	PTV2	PTV1	PTV2
Plan	6200	5084	800	≈0	7000	5084

Case #3

TG-275

High Risk Failure Modes for initial plan/chart review

FM#	Process Step	Failure Mode	Cause	RPN	S	O	D
16	Pre-Tx Review	Plan reviewed incorrectly by attending MD	Covering MD (not familiar with case details), MD rushed	138.9	4.5	4.2	5.5
35	Tx Plan	Suboptimal plan	Beam or arc arrangement suboptimal, not enough flash, field matching incorrect, optimization objectives missing or wrong , suboptimal field weighting	108.3	3.8	6.4	4.5
40	Pre-Tx Review	Physician peer review (chart rounds) not performed or inadequate	Standard procedure not followed (did not make it on list), not reviewed due to high-volume at chart rounds, policy for review is lacking	106.2	3.9	4.8	5.6

Case #3

TG-275

EBRT Initial plan/chart review checks from AAPM all-member survey

Physics Check Item	Corresponding FM	Highest RPN	Use Freq
PA-Q1-12: Peer review of treatment decision (e.g. tumor board, peer-to-peer evaluation , etc)	8,13,26,28,34, 40 ,77	160.2	17%
TP-Q4a-1: Target Planning Objectives	35	108.3	82%
TP-Q5-2: Target Coverage	17, 35 ,82	137.9	94%

A decorative graphic at the top of the slide consisting of a solid blue rectangular area above a series of overlapping, wavy, light blue shapes that create a sense of motion or a horizon line.

THANK YOU

Elekta

Paul McGrew, Global Product Support Engineer