SIMULTANEOUS BREAST BOOSTS: MAXIMIZING VALUE AND EFFICIENCY FOR PATIENTS

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1

OVERVIEW

- Review of current breast treatment fractionation schemes
- Potential for improving the patient experience
- Develop NRG 1005
- Presentation in Raystation and Eclipse
- Clinical Experience and Future Directions
- Questions

2

REVIEW

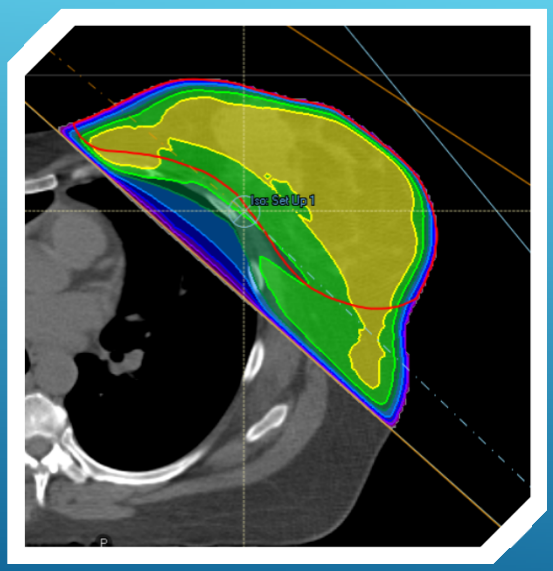
- Traditional treatment of high-risk, early-stage breast cancer
- The rise of hypo-fractionated breast treatments
- Comparison of outcomes between conventional and hypo-fractionated course
- Explain traditional sequential boosts used for hypo-fractionated treatments

3

Traditional treatment of high-risk, early-stage breast cancer

- Per the NIH website, current recommendations for radiation post-breast conserving therapy:
  - Decrease 10-year risk of recurrence
    - 19% vs 35%
  - Decrease 15-year risk of breast cancer death
    - 21% vs 25%

4



1.8 Gy to 2 Gy

daily fractions

5 to 6 weeks

total dose of 45 Gy to 50 Gy

CONVENTIONAL 3D WHOLE BREAST IRRADIATION (WBI)

5

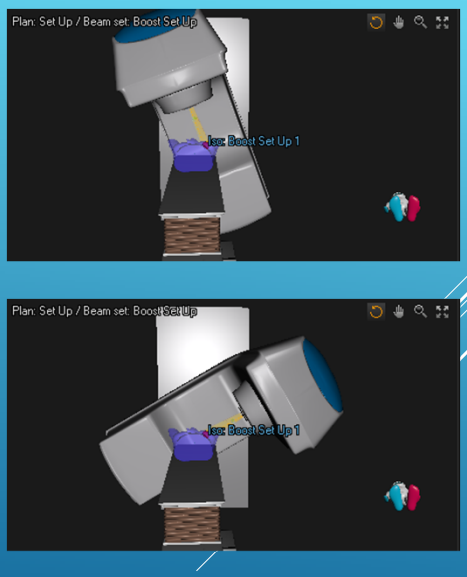
THE RISE OF HYPO-FRACTIONATED BREAST TREATMENTS

- Also, per the NIH website:
  - Shorter fractionation schedule appropriate
    - Same tangential fields as WBI
    - 42.5 Gy
    - Over 3-4 weeks
  - START trials
    - 4,451 women
    - Conventional vs. hypofractionation
    - No difference in 10 years

6

RADIATION BOOST

- 10-16 Gy
- 4-8 fxs
- Decrease 3-year risk from 4.6% to 3.6%
- Decreases 5-year risk from 7.3% - 4.3%
- Types of boost:
  - External beam photon
  - External beam electron
  - Interstitial radioactive implant



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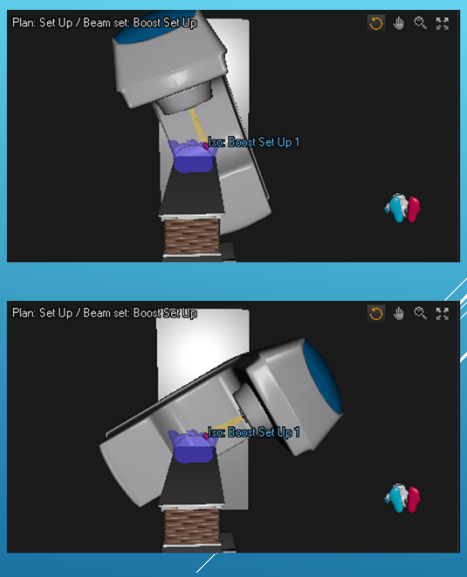

8

What if….

WE TREATED THE BOOST SIMULTANEOUSLY WITH THE TANGENTS.

9

NRG 1005- INTRODUCTION

- 48.0 Gy in 15 fractions with 3.2 Gy per day would result in an equivalent tumor bed dose of approximately 63-66 Gy in 2 Gy fractions
- Study supports hypofractionation comparing ≤ 2 Gy to > 2 Gy fraction sizes, no difference in cardiac mortality
- Cosmetic assessment using Global Cosmetic Score at baseline, 1 year, 3 years

10

WHY CHANGE FROM SEQUENTIAL TO SIMULTANEOUS BOOST?

FEWER TREATMENTS FOR PATIENTS

FEWER CHARGES ACCRUED

= HAPPY PATIENTS!

11

NRG 1005- PATIENT ELIGIBILITY

- Inclusion Criteria
  - Pathologically proven breast cancer resected by lumpectomy
  - Whole breast irradiation with boost without regional nodal irradiation planned
  - Breast-conserving surgery with:
    - Negative margins defined as no tumor at the resected specimen edge
    - Close resection margins > 0 mm to ≤ 2 mm
  - If multifocal breast cancer, then it must have been resected through a single lumpectomy incision with negative margins
  - Breast implants allowed

12

NRG 1005- PATIENT ELIGIBILITY

- Exclusion Criteria
  - AJCC pathologic T4, N2 or N3, M1
  - Pathologic stages III or IV
  - Nodal irradiation
  - Prior invasive non-breast malignancy -unless disease-free for a minimum of 5 years prior to study entry
  - DCIS only and age ≥ 50 years
  - Male breast cancer
  - Prior radiotherapy to the breast or prior radiation to the region of the ipsilateral breast
  - Concurrent chemotherapy
  - Severe, active co-morbidity

13

NRG 1005- PATIENT ELIGIBILITY

Essentially… High-Risk Early-Stage Breast Cancer

14

NRG 1005 – PATIENT POPULATION

- 2262 of 2354 randomized pts were eligible
- Median age 55 years
- 34% Stage II
- 52% Grade 3
- 30% ER-
- 17% close/+ margins consistent with a "High Risk" population

15

NRG 1005 ARMS

- Arm I
  - WBI 50 Gy in 25 fractions or 42.7 Gy in 16 fractions
  - Plus, a sequential boost of 12 Gy in 6 fractions or 14 Gy in 7 fractions
- Arm II
  - WBI 40 Gy in 15 fractions
  - Plus, a concomitant boost of 8 Gy in 15 fractions of 0.53 Gy per day

16

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17

NRG 1005-RESULTS

- Radiation was 3DCRT 81%, IMRT 19%
- With a median follow-up of 7.3 years the 5 and 7-year IBR were
  - 2.0% and 2.2% on Arm I
  - 1.9% and 2.6% on Arm II
- No differences in adverse events noted between arms:
  - 3.3% for Arm I
  - 3.5% for Arm II
- No difference in 3-year excellent/good cosmesis by arm:
  - 86% for Arm I
  - 84% Arm II

18

NRG 1005- CONCLUSIONS

Concomitant boost with WBI results in non-inferior IBR compared to sequential boost after WBI in high-risk cases and reduces overall treatment time

Using target-based 3DCRT or IMRT, there are no differences in toxicity or cosmetic outcome for concomitant vs. sequential boost

19

Target	Total Dose Rx (Gy)	Dose per Fx (Gy)	# of Fx	Fraction Schedule	Image Schedule	
PTV_p_Eval	40	2.67	15	Daily	Select	
PTV_p_Lump	48	3.2	15	Daily	Select	

SAMPLE TREATMENT PLANNING ORDER

RX

20

Target Coverage		
Target	Priority 4- Desired Dose Goals	Priority 2- Acceptable Dose Constraints
PTV_p_Eval (exclude Avoid_Skin_05)	$V_{95\% Rx PTV_p} \geq 95\%$	$V_{90\% Rx PTV_p} \geq 90\%$
	$D_{max} \leq 115\%$ Rx PTV_p	$D_{max} \leq 120\%$ Rx PTV_p
	$D_{30\%} \leq 100\%$ Rx PTV_p_Lump	$D_{35\%} \leq 100\%$ Rx PTV_p_Lump
	$D_{50\%} \leq 43.2$ Gy	$D_{50\%} \leq 44.8$ Gy
PTV_p_Lump	$V_{95\% Rx PTV_p_Lump} \geq 95\%$	$V_{90\% Rx PTV_p_Lump} \geq 90\%$
	$D_{5\%} \leq 110\%$ Rx PTV_p_Lump	$D_{10\%} \leq 110\%$ Rx PTV_p_Lump
	$D_{max} \leq 115\%$ Rx PTV_p_Lump	$D_{max} \leq 120\%$ Rx PTV_p_Lump

SAMPLE TREATMENT PLANNING ORDER **TARGET GOALS**

21

Organs at Risk		
Organ	Priority 3 - Goal	Priority 1 - Constraint
☒ Heart (LEFT SIDED)	$V_{16\ Gy} < 5\%$	$V_{20\ Gy} < 5\%$
	$V_{8\ Gy} < 30\%$	$V_{8\ Gy} < 35\%$
	$D_{mean} < 3.2$ Gy	$D_{mean} < 4$ Gy
☐ Heart (RIGHT SIDED)	$V_{16\ Gy} < 0\%$	$V_{20\ Gy} < 0\%$
	$V_{8\ Gy} < 10\%$	$V_{8\ Gy} < 15\%$
	$D_{mean} < 3.2$ Gy	$D_{mean} < 4$ Gy
☒ Ipsilateral Lung	$V_{16\ Gy} < 15\%$	$V_{16\ Gy} < 20\%$
	$V_{8\ Gy} < 35\%$	$V_{8\ Gy} < 40\%$
	$V_{4\ Gy} < 50\%$	$V_{4\ Gy} < 55\%$
☒ Contralateral Lung	$V_{4\ Gy} < 10\%$	$V_{4\ Gy} < 15\%$
☒ Contralateral Breast	ALARA	ALARA

SAMPLE TREATMENT PLANNING ORDER **ORGANS AT RISK**

22

BEAM ARRANGEMENTS

Tangents for 2.67 Gy per fraction

Additional 1-3 beams for 0.53 Gy to the lumpectomy cavity

En face electron

Wedge pair

Conformal arc

Pick your technique based on lumpectomy location and shape

Medial

Lateral

Superficial

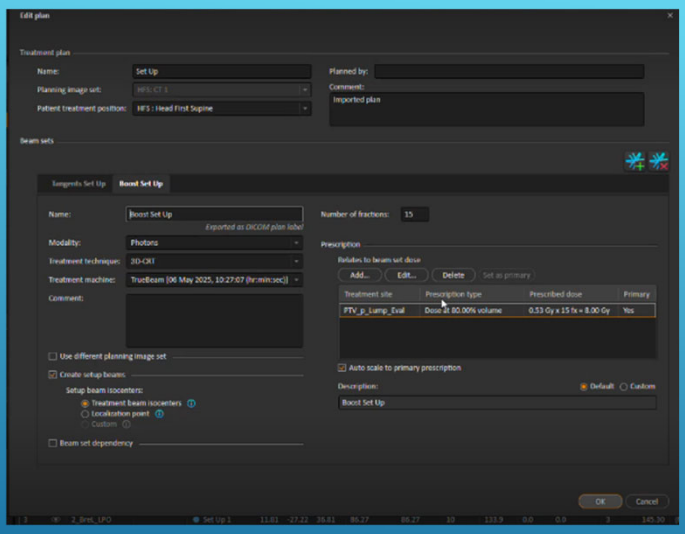
Deep

Irregular vs conformal shape

23

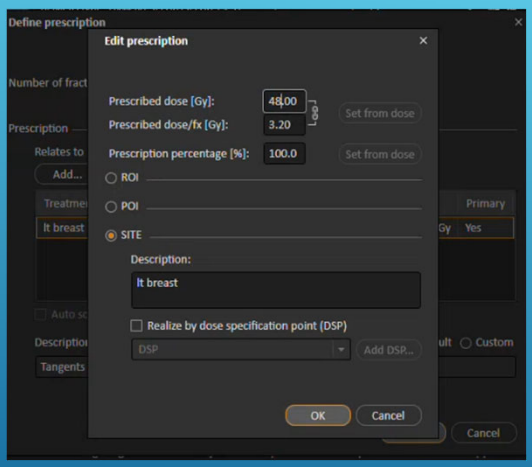
Raystation

24



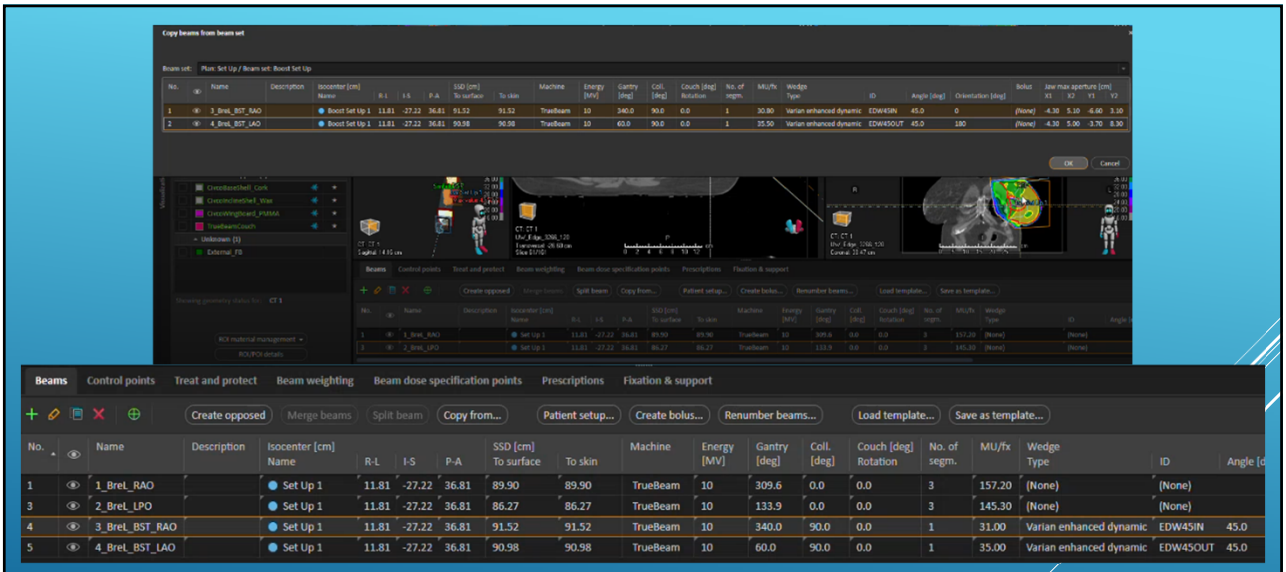
Two beam sets initially – Primary to 40 Gy, boost to 8Gy

25



Once plans are finalized, turn off auto-scale (if enabled) and change prescription from ROI to "site" – change rx to higher dose level

26



Beams | Control points | Treat and protect | Beam weighting | Beam dose specification points | Prescriptions | Fixation & support

Create opposed | Merge beams | Split beam | Copy from... | Patient setup... | Create bolus... | Renumber beams... | Load template... | Save as template...

No.		Name	Description	Isocenter [cm] Name	R-L	I-S	P-A	SSD [cm] To surface	To skin	Machine	Energy [MV]	Gantry [deg]	Coll. [deg]	Couch [deg] Rotation	No. of segm.	MU/fx	Wedge Type	ID	Angle [d
1		1_Brel_RAO		Set Up 1	11.81	-27.22	36.81	89.90	89.90	TrueBeam	10	309.6	0.0	0.0	3	157.20	(None)	(None)	
3		2_Brel_LPO		Set Up 1	11.81	-27.22	36.81	86.27	86.27	TrueBeam	10	133.9	0.0	0.0	3	145.30	(None)	(None)	
4		3_Brel_BST_RAO		Set Up 1	11.81	-27.22	36.81	91.52	91.52	TrueBeam	10	340.0	90.0	0.0	1	31.00	Varian enhanced dynamic	EDW45IN	45.0
5		4_Brel_BST_LAO		Set Up 1	11.81	-27.22	36.81	90.98	90.98	TrueBeam	10	60.0	90.0	0.0	1	35.00	Varian enhanced dynamic	EDW45OUT	45.0

"Copy From" and review beams came over appropriately
(Be sure to delete boost beamset after)

27

- Wedge pair
  - Allows conformal coverage without giving extra dose to uninvolved breast
- Three-fields
  - Puts less dose into lung and heart
  - More dose to uninvolved breast
- Auto Field in Field
  - Less robust FiF
  - More conformal with optimizer
- Same planning technique and isocenter allows for seamless treatment delivery

RAYSTATION TAKE-AWAYS

28

RAYSTATION TAKE-AWAYS

- Using a different planning technique (ie conformal arc or electron) yields longer treatment time daily
- Electron
  - Best at preserving uninvolved breast and dose falls off into lung very quickly
  - Runs hot
- Conformal arc
  - Conformal, uniform dose
  - Puts integral low dose entirety of arc

29

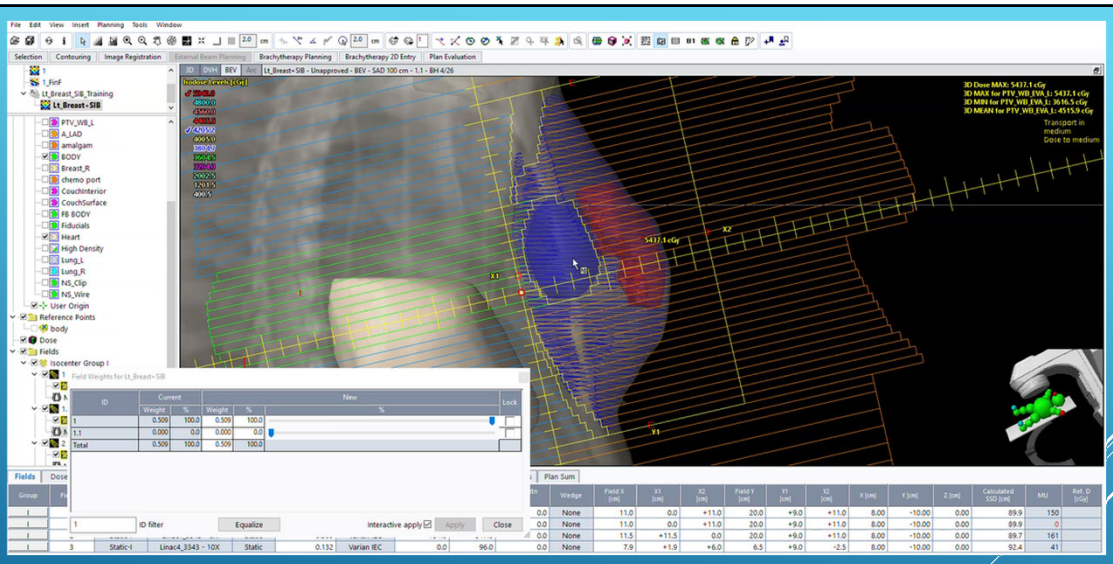
Eclipse

30

FIELD IN FIELD WITH ECLIPSE

- Create Whole Breast plan and normalize coverage (Allow space for Field in Fields to reduce 105%)
- Add Boost Field to same plan, adjust weight to Boost field only until coverage goal is met
- Utilize Field in Fields to reduce 105% for both 4005cGy and 4800cGy
- Adjust Rx to Highest dose level

31



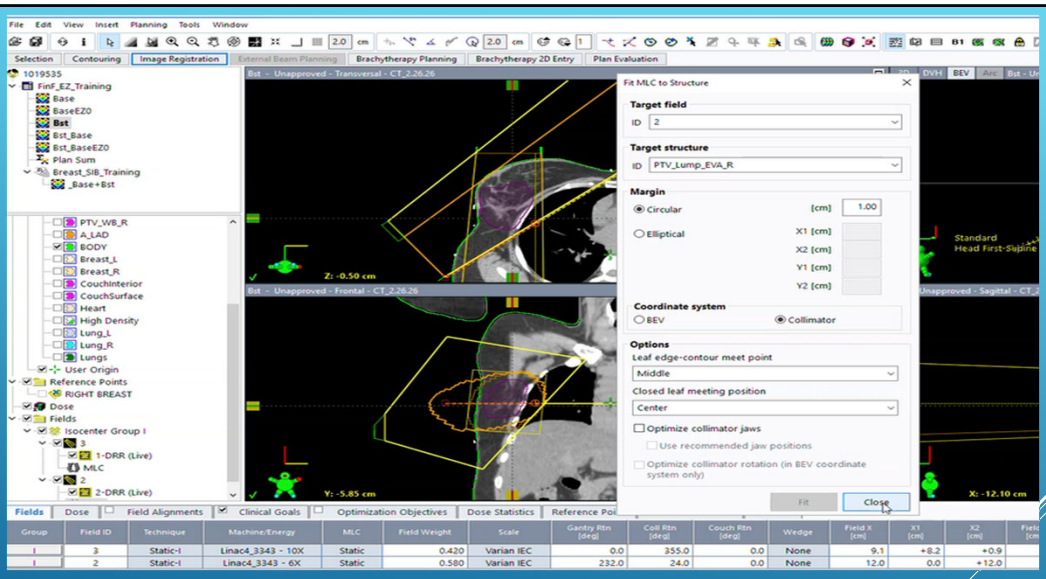
FIELD-IN-FIELD TECHNIQUE ALL IN ONE PLAN

32

FIELD-IN-FIELD TECHNIQUE USING EZ FLUENCE

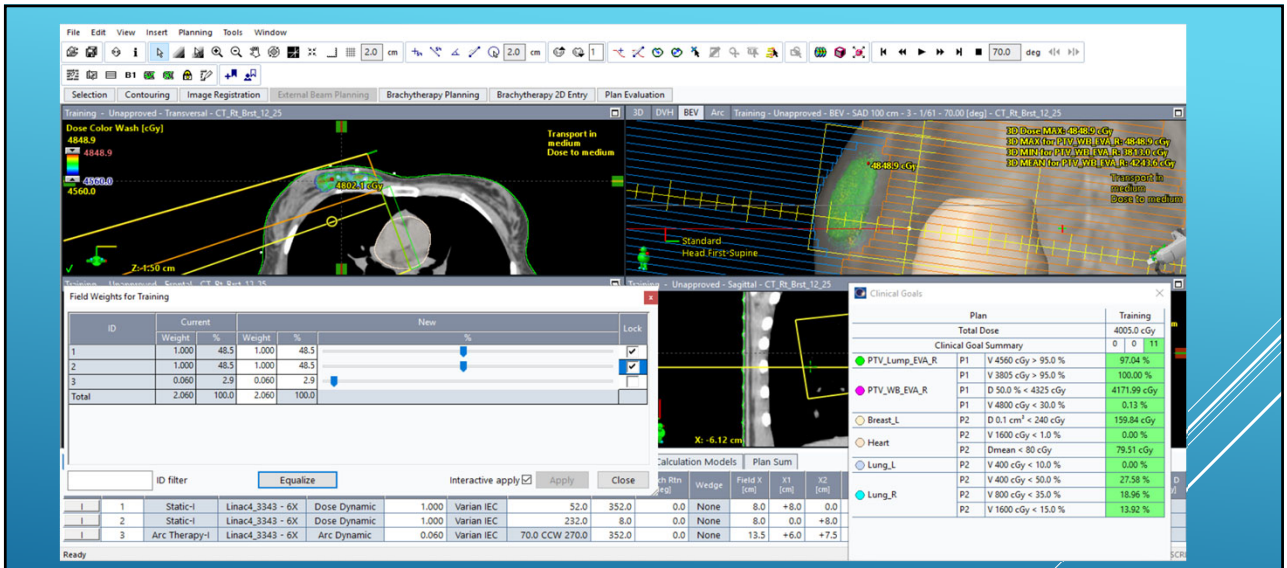
- Setup WB and Boost ~ same as sequential boost plan using Field in Field (separate plans)
- Copy and paste your boost fields into the WB plan (Tedious)
- Keep your jaw position the same in the boost plan if you are using the same gantry position as the WB plan
- Calc with preset MU from boost plan (Tedious)
- Merge subfields
- Adjust Rx to the highest dose level

33



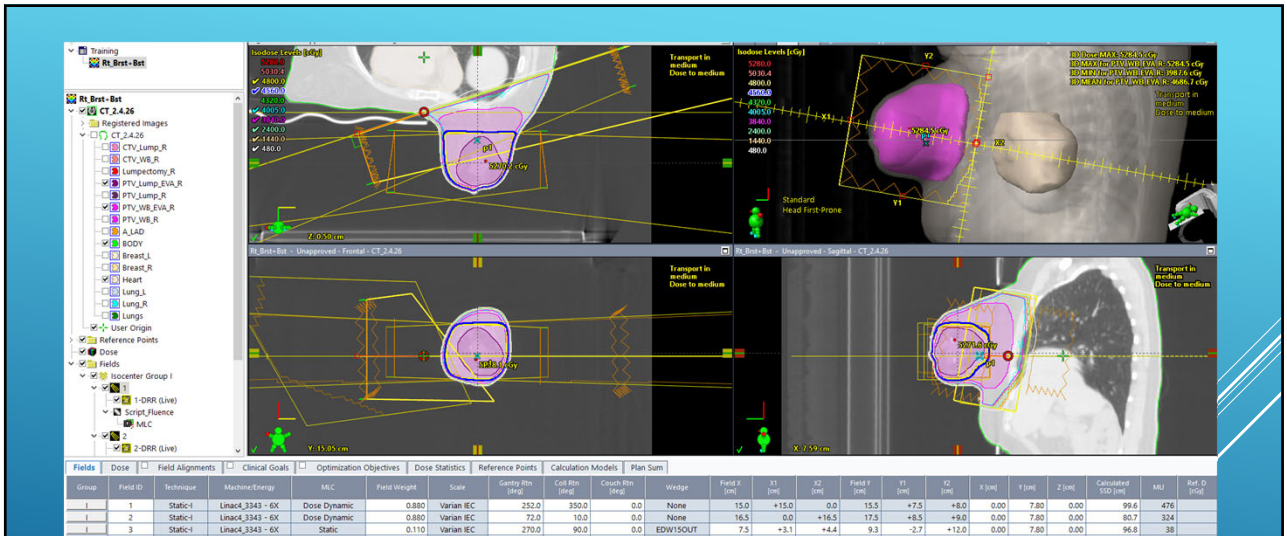
FIELD-IN-FIELD TECHNIQUE USING EZ FLUENCE

34



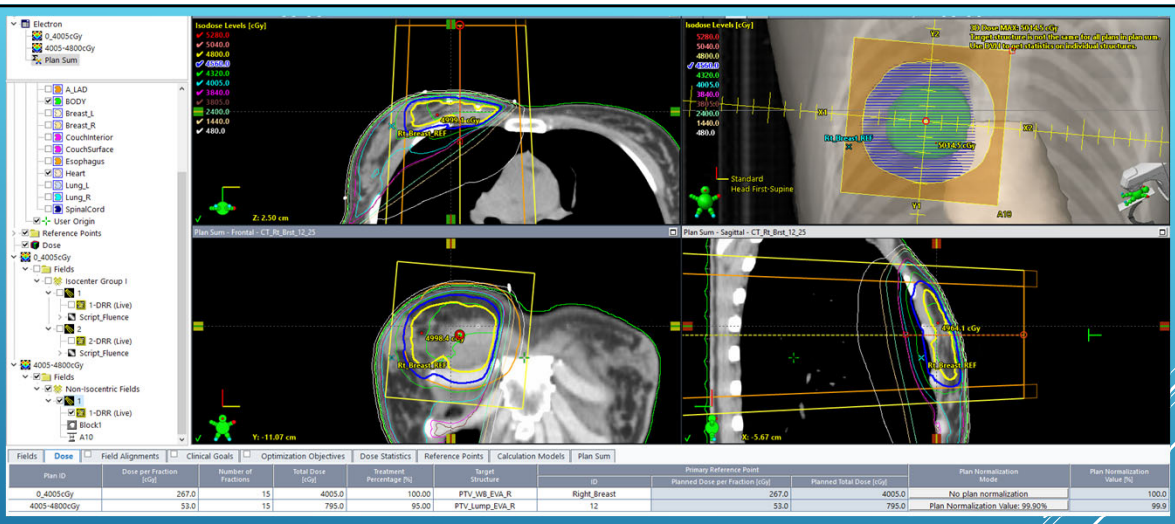
DYNAMIC CONFORMAL ARC ~ MEDIAL AND SUPERFICIAL

35



PRONE ~

36



Plan ID	Dose per Fraction [cGy]	Number of Fractions	Total Dose [cGy]	Treatment Percentage [%]	Target Structure	Primary Reference Point ID	Primary Reference Point Planned Dose per Fraction [cGy]	Primary Reference Point Planned Total Dose [cGy]	Plan Normalization Mode	Plan Normalization Value [%]
0_4005cGy	267.0	15	4005.0	100.00	PTV_WB_EVA_R	Right_Breast	267.0	4005.0	No plan normalization	100.0
4005-4800cGy	53.0	15	795.0	95.00	PTV_Lump_EVA_R	12	53.0	795.0	Plan Normalization Value: 99.90%	99.9

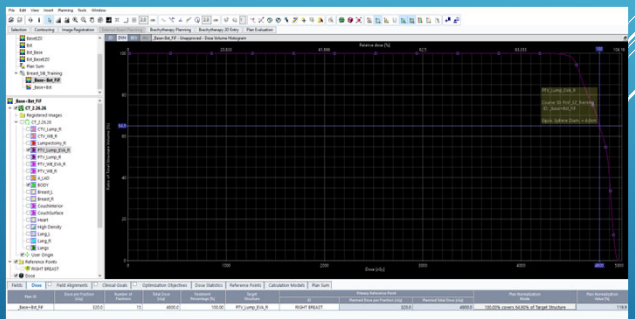
ELECTRONS ~ ENFACE
- SEPARATE PLAN FOR BOOST (CLINICAL SETUP)

37

- When adding weight/MU to the boost field lock the weight for the Tangent beams
- When setting up the boost fields keep jaws at the same position as you whole breast plan (do not optimize jaw setting when fitting MLC)

MAIN TAKEAWAYS

- Utilize the 'calc with preset MU when combining plans
- When adjusting the Rx to the higher dose level
  - Determine the PTV lump coverage and normalize the plan to that value



38

ECLIPSE SUMMARY

- Your departments preferred sequential WB + Boost can be adopted into your WB + SIB workflow
- All in one planning Field in Field, DCA, Ecomp
- Combining whole breast plan with boost utilizing the tools you have (EZFluence)
- We may see this approach with node positive patients soon…

39

IN SUMMARY

- High-risk breast cancer patients can benefit from simultaneous breast boosts in hypofractionated courses
- Multiple approaches available to treat SIB with 3DCRT
  - Wedge pair
  - 3-Field
  - Electron
  - Conformal arc
- No change in clinical outcomes compared to sequential boost

40

CLINICAL EXPERIENCE

- Contraindications not listed : large lumpectomy cavities
- SIB vs sequential boost : sequential is tried and true, but early reports are encouraging if scheduling becomes a barrier
- Cosmetic outcomes with trial margins were notable due to larger volumes and higher boost dose
- IMPORT-HIGH: comparable study out of Europe yielded similar results

41

FUTURE DIRECTIONS

FAST-FORWARD with SIB

Hypo-fractionated four-field with SIB

42

RESOURCES

- Jessica: jjohnson6@uwhealth.org
- Joe: joseph.pagano@roswellpark.org
- NIH website: Breast Cancer Treatment (PDQ®) - NCI
- NRG Trial 1005

43