



Department of  
Radiation Oncology

# PRONE WHOLE BREAST RADIOTHERAPY ON ETHOS

WORKFLOW, FLASH VERIFICATION AND  
CLINICAL FEASIBILITY

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## LEARNING OBJECTIVES

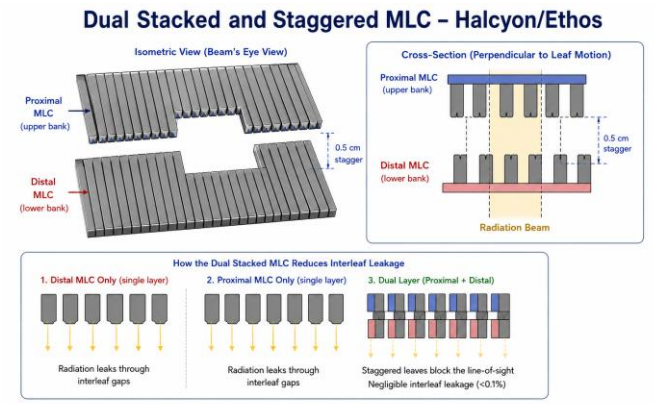
- Describe a reproducible 3D prone breast workflow on the Varian Ethos Therapy System using EZFluence and CBCT based flash verification
- Compare dosimetric outcomes between Varian Ethos Therapy System and Varian TrueBeam using 14 replanned cases and a 5 patient clinical pilot
- Explain the development and clinical application of a flash verification structure
- Apply practical planning and treatment delivery strategies for prone breast treatments on Ethos

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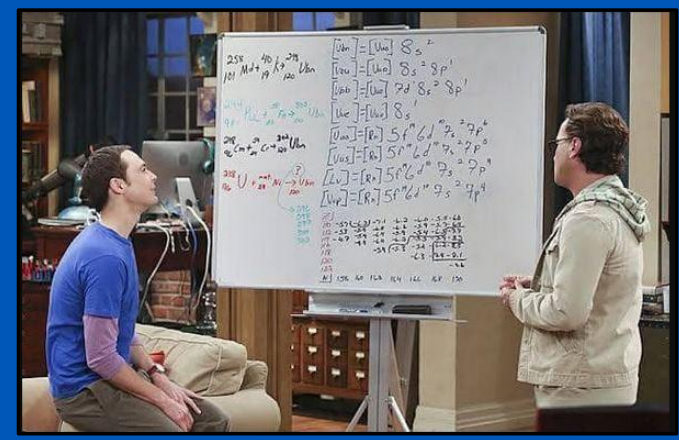
# ETHOS TREATMENT MACHINE

- Designed primarily for adaptive workflows
- Limited guidance for non-adaptive (3D) workflows on Ethos/Halcyon units
- Advanced CBCT adaptive imaging workflow
- Stacked and staggered dual layer MLC
  - No jaws
  - < 0.1% interleaf leakage
  - 28x28cm field size
- 6FFF only



Adapted from: Lim TY, Dragojevic I, Hoffman D, Flores-Martinez E, Kim GY. Characterization of the Halcyon™ multileaf collimator system. *J Appl Clin Med Phys.* 2019;20(4):106-114.

# FOR THE PHYSICS ENTHUSIASTS IN THE ROOM...



### WHY PRONE BREAST ON ETHOS?

Predictable anatomy and setup geometry

Smaller separations → suitable for 6FFF

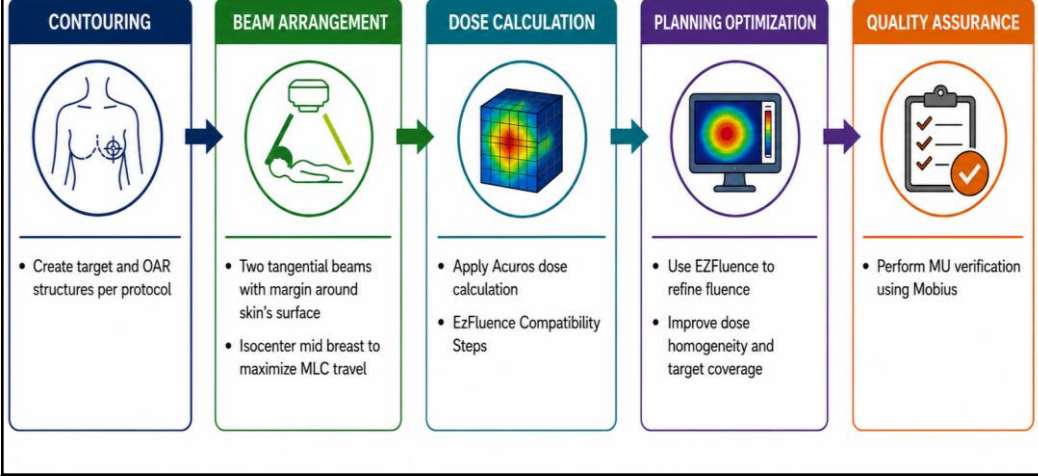
Visual clearance check during treatment planning

Compatible with EZFluence 3D planning

5 -10x faster CBCT

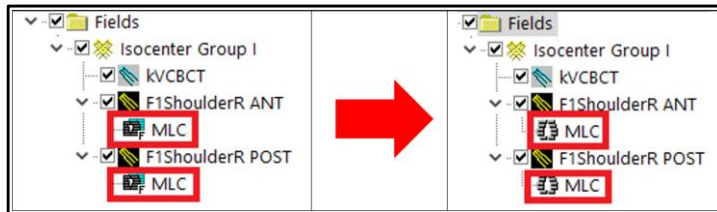
Supported department load leveling goals between treatment machines

### Ethos Prone Breast Workflow

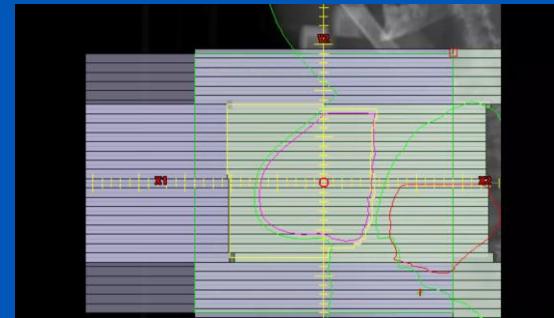


## Ethos Prone Breast Workflow

- ✓ Right click on each field's MLCs and select "Remove Flattening Sequence"
- ✓ Under Calculation Options, set plan dose calculation to OFF
- ✓ Ready for EZFluence!



## METHODS – RETROSPECTIVE PLANNING STUDY



- 14 previously treated prone breast cases
  - TrueBeam
  - AAA
- Replanned on Ethos treatment unit
  - AcuroSXB
  - EZFluence eComp fields

## METHODS – RETROSPECTIVE PLANNING STUDY

### Planning criteria

- Gantry + CBCT clearance
- Patient separation suitability
- Standard tangent geometry
- Right and Left breast cases

### Metrics Evaluated

- Planning time
- Monitor Units (MU)
- Target heterogeneity
- OAR compliance
- Target coverage



## TRUEBEAM VS ETHOS: FAVORABLE ANATOMY COHORT (N=10)

### Key Findings

- Planning time: comparable using the EZFluence workflow
- OAR doses: comparable and met all planning constraints
- MU: Overall comparable with a slight trend lower in Ethos plans
- Heterogeneity: Mild increased in Ethos plans

Metric	TrueBeam	Ethos	Overall Trend
D90%	~98-100%	~97-101%	Comparable
D95%	~95-100%	~94-100%	Comparable
Max Dose in PTV	~104-106%	~105-107%	Mild increase on Ethos
V105%	~0-0.4%	~0-1%	Minimal increase on Ethos
V104%	~0-16%	~0-9%	Similar dose homogeneity
Mean Heart Dose	~8-53cGy	~24-55cGy	Comparable
Ipsilateral Lung V5Gy	~0-2%	~0-3%	Comparable

## PLAN COMPARISON – FAVORABLE ANATOMY EXAMPLES

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## PLAN COMPARISON – FAVORABLE ANATOMY

**Separation = 18cm**

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## TRUEBEAM VS ETHOS: UNFAVORABLE ANATOMY COHORT (N=4)

### Additional Finding

- Select higher-separation patients (~20cm or greater): Ethos 6FFF plans showed:
  - Increased hotspots
  - Increased heterogeneity
  - Lower target coverage
- Recommended for planning on TrueBeam with 10X beam energy

Metric	TrueBeam	Ethos	Overall Trend
D90%	~99-100%	~96-100%	Mild reduction on Ethos
D95%	~97-98%	~93-97%	Reduced coverage on Ethos
Max Dose in PTV	~105-108%	~106-118%	Increased hotspots on Ethos
V105%	~0-5%	~0-9%	Higher hotspot volume on Ethos
V104%	~7-19%	~16-17%	Reduced homogeneity on Ethos
Mean Heart Dose	~19-58cGy	48-89cGy	Increased heart dose on Ethos
Ipsilateral Lung V5Gy	~0-5%	~0-6%	Slight increase on Ethos

## PLAN COMPARISON – UNFAVORABLE ANATOMY

Case	Separation	V105%		Global Hot Spot		Heart Mean	
		TrueBeam	Ethos	TrueBeam	Ethos	TrueBeam	Ethos
1	25cm	4.70%	9%	107.70%	117.60%	57.9cGy	66.5cGy
2	28cm	2.90%	6.20%	107%	108%	38.2cGy	52cGy
3	21cm	1.30%	5.60%	106.90%	111.10%	30.4cGy	48.3cGy
4	19cm	0%	1.20%	104.90%	110.30%	19.4cGy	89.2cGy

## PLAN COMPARISON – UNFAVORABLE ANATOMY

**Separation = 21cm**

**Isodose Levels [%]**

- ✓ 110.0
- ✓ 105.0
- ✓ 100.0
- ✓ 95.0
- ✓ 90.0
- ✓ 85.0
- ✓ 75.0
- ✓ 50.0
- ✓ 25.0
- 10.0

**TrueBeam**

Z: 14.00 cm

**Isodose Levels [%]**

- ✓ 110.0
- ✓ 105.0
- ✓ 100.0
- ✓ 95.0
- ✓ 90.0
- ✓ 75.0
- ✓ 50.0
- ✓ 25.0
- 10.0

**Ethos**

Z: 14.00 cm

## PLAN COMPARISON – UNFAVORABLE ANATOMY

**Separation = 25cm**

**Isodose Levels [%]**

- ✓ 110.0
- ✓ 105.0
- ✓ 100.0
- ✓ 95.0
- ✓ 90.0
- ✓ 75.0
- ✓ 50.0
- ✓ 25.0
- 10.0

**Truebeam**

Z: 3.60 cm

**Isodose Levels [%]**

- ✓ 110.0
- ✓ 105.0
- ✓ 100.0
- ✓ 95.0
- ✓ 90.0
- ✓ 75.0
- ✓ 50.0
- ✓ 25.0
- 10.0

**Ethos**

Z: 3.60 cm

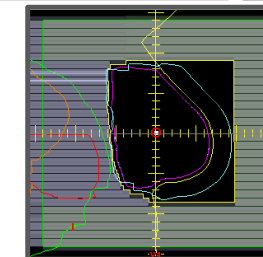
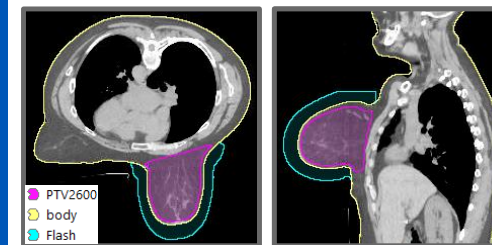
## FLASH VERIFICATION CHALLENGE ON ETHOS

- ✗ Light field
- ✗ MV portal imaging
- ✗ Direct verification of treatment field

**Big Question:** *How do we verify adequate flash before treatment?*

## FLASH VERIFICATION STRUCTURE: OUR SOLUTION

- Created during treatment planning by dosimetry
- Represents the planned treatment field margin
- Used for CBCT-based verification in Ethos



Typical dosimetric margins include:

- 1-2cm superiorly and inferiorly
- 3cm anteriorly

## FLASH VERIFICATION STRUCTURE WORKFLOW

Radiation therapists acquire daily CBCT

Align patient per prone breast matching SOP

Turn on flash structure

Toggle between the planning CT and the CBCT to evaluate breast position

**Purpose of the Flash Structure**

- Verify the patient's breast tissue is within the field prior to treatment delivery

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## FLASH STRUCTURE EVALUATION RESULTS

**Breast Tissue Evaluation Outcomes**

- **Within flash**
  - Proceed with treatment
- **Outside flash**
  - Verify patient alignment and reposition if needed
  - Notify dosimetry and care team

Planning CT = Orange color wash  
CBCT = Blue color wash

Flash = Yellow contour  
PTV = Orange contour

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## ETHOS PRONE BREAST CLINICAL PILOT

### WORKFLOW INTEGRATION AND CLINICAL FEEDBACK

**Patient Cohort**

- 5 prone breast patients
- CQ Medical Access Prone G2 Breast Device used for prone positioning
- Flash Structure used in 3/5 cases
- Patient separations ranged from 12.5-22cm

**Workflow Integration**

- Ethos planning performed using EZFluence workflow
- Flash structure generated during planning to define field margins for setup verification
- CBCT-based alignment included in treatment delivery

**RTT Feedback**

- No workflow issues reported
- CBCT-based IGRT workflow similar to TrueBeam
- Flash Structure replaces light field/MV port verification
- Reproducible patient setup in all cases

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## ETHOS PRONE BREAST CLINICAL PILOT

### CLINICAL FEASIBILITY AND DOSIMETRIC OUTCOMES

**Feasibility Outcomes**

- Ethos planning with EZFluence was completed efficiently
- No workflow issues were observed
- No increase in planning time
- Flash structure supported CBCT-based setup verification
- Positive RTT feedback on alignment and delivery workflow

**Dosimetric Outcomes**

- All pilot plans met target coverage goals and OAR constraints
- Dose homogeneity remained within acceptable clinical limits
- Hotspots remained within clinical thresholds
- Overall plan quality met institutional standards

***The Ethos prone breast planning workflow proved clinically feasible, reproducible and dosimetrically sound.***

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## PRACTICAL WORKFLOW AND PATIENT SELECTION STRATEGIES

### Workflow Strategies

- Complete pre-planning steps for EZFluence compatibility
- Use mid-breast isocenter to reduce MLC travel limitations
- Use flash structure to verify adequate flash prior to delivery

### Patient Selection

- Favor smaller-separation patients for Ethos planning
- Consider TrueBeam 10X for select higher separation cases (~20cm+)
- Expand workflow to suitable SIB and PBI mini tangent cases

### Planning Decisions

- Ethos provides increased clearance that can be evaluated during planning
- Consider TrueBeam 10X for deep-seated cavity locations

## CONCLUSIONS AND CLINICAL IMPLEMENTATION

- A reproducible 3D prone breast workflow on Ethos was successfully developed using EZFluence and CBCT-based flash verification.
- A flash verification structure was established to enable reliable post-alignment confirmation of breast positioning within the treatment field.
- Dosimetric evaluation across 14 replanned cases and a 5 patient clinical pilot demonstrated clinically acceptable and comparable plan quality between Ethos and TrueBeam.
- Practical workflow strategies were identified to support efficient and consistent delivery of prone breast treatments on Ethos.

***Prone whole breast radiotherapy on Ethos is now standard practice at our clinic.***

**QUESTIONS  
& ANSWERS**



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