

BACKGROUND

- Validation and quality assurance tests were performed in commissioning the treatment planning software used by the Varian Ethos system.
- Ethos requires the use of a standard vendor-provided beam model; thus the machine is adjusted to match the beam model.
- This differs from the historical approach in which a software model is generated to characterize the treatment machine.

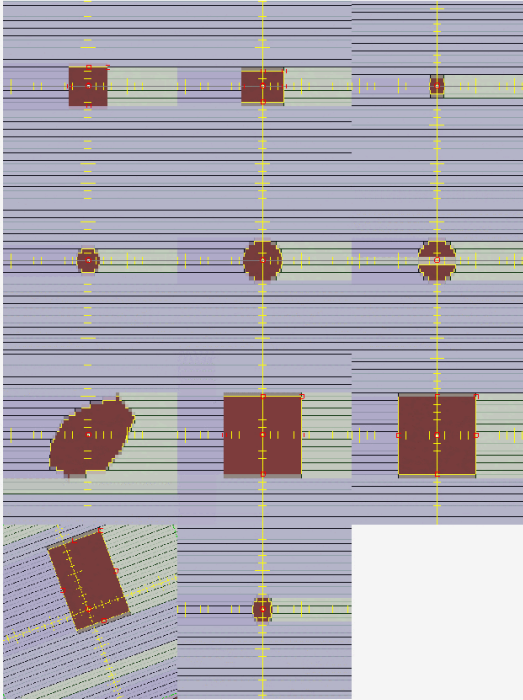
TPS SYSTEM TESTS

The following features were evaluated prior to performing dose measurements to confirm that the system was behaving as expected:

- CT CALIBRATION CURVE VALIDATION**
Mass density and electron density curves were validated against the clinically used values.
- DOSE CALCULATION**
Dose calculated in Ethos is compared to that calculated in Eclipse for an identical plan.
- VOLUME DELINEATION**
Structure volume consistency was tested with a volume phantom. Structure volume integrity was tested with imported structures, exported structures, and structures given asymmetric and symmetric margins.
- ISOCENTER ASSIGNMENT**
Isocenters assigned by structure within the Ethos system were compared to the expected values.
- DENSITY ASSIGNMENT**
Validation that the density assigned by the selected material in Ethos corresponds to the expected material density.
- DVH METRICS**
Metrics reported by Ethos and Eclipse for identical dose distributions were compared.

DOSE MEASUREMENTS

- Validation measurements were designed based on those described in MPPG5a . These measurements were performed to confirm that the dose calculated by Eclipse for relatively simple treatment fields matches the dose delivered by the machine.
- Treatment fields were designed in the Eclipse Treatment Planning Software with 200 MU and a 100 cm source-to-surface distance (SSD) of 100 cm.
- Reference dose was calculated in Eclipse using AcurosXB version 15.606 with a calculation resolution of 0.25 cm. The BEV of each field is given in the figure below.
- Measurements were performed on using a microDiamond detector cross-calibrated with an expected dose and confirmed with an ADCL-calibrated Farmer Chamber



Beams-eye-view of the fields designed for MPPG5a measurements; **(1)** 5×5 cm square **(2)** 5.5×4.0 cm rectangle **(3)** 2.0 cm diameter circle, MLCs set to outside **(4)** 3.0 cm diameter circle, MLCs set to middle **(5)** 5.0 cm diameter circle, MLCs set to middle **(6)** 5.0 cm diameter circle with central axis blocked, MLCs set to middle **(7)** Hand-drawn asymmetric shape **(8)** 10×10 cm square, gantry at 20° **(9)** 10×10 cm Square **(10)** Asymmetric off-axis rectangle, collimator at 20° **(11)** 2.5 cm diameter circle, MLCs set to outside.

RESULTS			
	QUANTITY	TOLERANCE	RESULT
DOSE CALCULATION			
Absolute Validation <i>Comparison of calculated dose to that measured in a water tank for MPPG5a fields.</i>	$\Delta_{\text{meas}} = D_{\text{meas}} - D_{\text{TPS}} \div D_{\text{TPS}}$	3%	1.3%
Relative Validation <i>Comparison of dose calculated by the Ethos TPS and that calculated by the Eclipse TPS.</i>	$\Delta_{\text{TPS}} = D_{\text{Ethos}} - D_{\text{Eclipse}} \div D_{\text{Eclipse}}$	2%	1.2%
VOLUME REPRESENTATION			
Volume Integrity <i>Comparison of structures contoured in Eclipse and transferred to Ethos.</i>	$\Delta_{V,\text{Eclipse,Ethos}} = \frac{ V_{\text{Ethos}} - V_{\text{Eclipse}} }{V_{\text{Eclipse}}}$	2%	0.5%
Volume Accuracy <i>Comparison of structures delineated on a known-volume phantom in Eclipse to those contoured in Ethos.</i>	$\Delta_{V,\text{Eclipse,Ethos}}$	3%	1.9%
Volume Integrity II <i>Comparison of structures contoured in Ethos and transferred to Eclipse.</i>	$\Delta_{V,\text{Eclipse,Ethos}}$	2%	0.3%
Margin Integrity <i>Comparison of structures generated with a symmetric margin in Eclipse to the same volume generated in Ethos.</i>	$\Delta_{V,\text{Eclipse,Ethos}}$	3%	1.0%
Margin Integrity - Asymmetric <i>Comparison of structures generated with an asymmetric margin in Eclipse to the same volume generated in Ethos.</i>	$\Delta_{V,\text{Eclipse,Ethos}}$	3%	8.1%
ISOCENTER			
Isocenter Assignment <i>Comparison of the expected isocenter coordinates and those assigned using the structure-based isocenter assignment feature in Ethos.</i>	$\Delta_{\text{iso}} = (\Delta_x^2 + \Delta_y^2 + \Delta_z^2)^{1/2}$	2 mm	1.1 mm
MATERIAL DENSITIES			
Density Assignment <i>Comparison of the density assigned by Ethos and the density of those materials according to the physical material table in Eclipse.</i>	$\Delta_{\rho} = \rho_{\text{Ethos}} - \rho_{\text{Eclipse}} \div \rho_{\text{Eclipse}}$	1%	0.0%
DOSE VALUE REPRESENTATION			
DVH Metrics <i>Comparison of the DVH values reported by Ethos to those reported for the identical dose distribution in Eclipse.</i>	$\Delta_{\text{DVH}} = \frac{ DVH_{\text{Ethos}} - DVH_{\text{Eclipse}} }{DVH_{\text{Eclipse}}}$	3%	1.3%