

Investigating the dosimetric consequences of Eclipse couch rail modelling

Karl D Spuhler, PhD; K. Sunshine Osterman, PhD
NYU Langone Health New York, NY

PURPOSE

Standard practice is to either to avoid beam entry through couch rails and support structures or to include the rails and couch in the treatment plan. VMAT treatments make complete rail avoidance for a subset of patients unrealistic; moreover, setup error may result in fields entering through rails unintentionally.

Eclipse rail models use a simplified technical drawing as opposed to a CT image or precise technical drawing that includes the full rail structure.

We present measurements which quantify the consequences of simplified rail models for a number of nominal fields and arc delivered through rails.

METHODS

All measurements were performed using an ArcCheck® detector aligned at the isocenter of a Varian Truebeam® LINAC and compared with calculated distributions from Eclipse.

Data were acquired with and without rails present using 6MV, 100MU, 10x10cm fields at a number of posterior angles, as well as angles of 0 and 90 to investigate backscatter and provide a reference measurement.

Partial arcs through the posterior rail section were also analyzed. Gamma analysis pass rates were determined at 3%/3mm, 2%/2mm and 1%/1mm using a threshold of 10%. Measurements were acquired using a Varian TrueBeam® and kVue™ Couch Top.

FIGURES

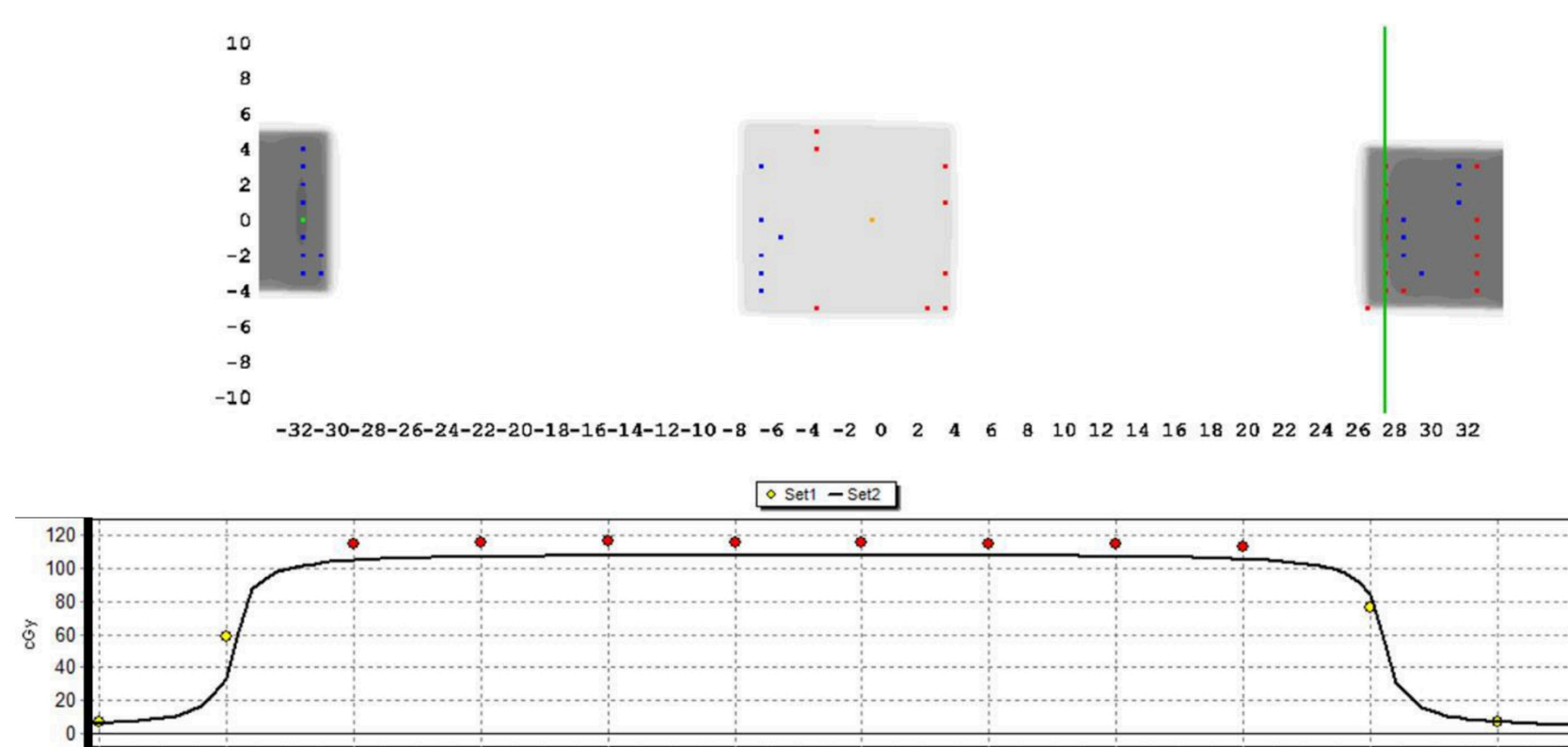


Figure 1. Gamma distribution and profile for 170 gantry angle, 1%/1mm passing rate.

Gantry Angle	Rails In			Rails Out		
	3%/3mm	2%/2mm	1%/1mm	3%/3mm	2%/2mm	1%/1mm
90	100%	100%	94.4%	100%	100%	94.4%
0	100%	100%	94.4%	100%	100%	94.4%
180	88.8%	84.1%	60.3%	100%	100%	90.1%
175	94.8%	87.5%	71.1%	100%	100%	89.2%
170	94.4%	92.3%	79.9%	100%	100%	90.5%
165	93.3%	90.8%	76.5%	100%	100%	96.2%
160	96.7%	95.0%	82.1%	100%	100%	97.1%
155	92.9%	90.4%	68.6%	96.7%	96.7%	84.1%
150	93.3%	89.4%	72.5%	95.0%	92.1%	78.2%
10x10cm Arc (180-143)	100%	99.4%	94.9% 83.1% at 50% TH	N/A	N/A	N/A
5x5cm Arc (180-143)	99.0%	94.0%	78.0% 57.1% at 50% TH	N/A	N/A	N/A

RESULTS

Results for gantry angles of 90 and 0 were identical, suggesting no effect of rail model on backscatter accuracy.

Gamma passing rates were lower for all posterior fields delivered through rails as opposed to those delivered without the rail. Dosimetric errors, both hot and cold, were observed in regions of beam entry and exit.

All distributions showed point errors in exceeding 5%. Passing rates were higher, relative to static fields, for the 10x10cm arc, but comparable for the 5x5cm arc.

When limiting the analysis to the region measuring entrance dose, gamma pass rates dropped to 83% and 57% for the 10x10 and 5x5 arcs, respectively.

CONCLUSIONS

Eclipse rail models are largely accurate for large fields and do not appear to introduce significant error at conventional gamma analysis levels.

At the 1%/1mm level there is considerable dosimetric inaccuracy impacting both static and arc fields.

CONTACT INFORMATION

Karl D Spuhler, PhD
karl.spuhler@nyulangone.org