

Photon Beam Matching Analysis at Multiple Sites Up To Twelve Years Post Installation

C. Able, R. Zakikhani, K. Yan, D. Sha, A. Chopra

Objective: To determine if the photon beams associated with several models of accelerators are matched with ‘Golden Beam’ data (VGBD) to assess treatment planning modeling and delivery.

Materials and Methods: Six accelerators’ photon beams were evaluated to determine if they matched the manufacturer’s (Varian Medical Systems, Inc.) VGBD. Additional direct comparisons of the 6X and 18X beams using the manufacturer’s specification of Basic and Fine beam matching were also performed. The C-series accelerator models were 21 EX (3), IX (2), and a IX Trilogy, ranging from three to twelve years post installation. Computerized beam scanning was performed (IBA Blue Phantom 2) with 2 CC13 ion chambers in water at 100 cm SSD. Dmax (10 cm² field size), percentage depth dose (6 cm², 10 cm², 20 cm², and 30 cm² field sizes) and beam uniformity (10 cm², 30 cm², and 40 cm² field sizes) were evaluated.

Results: When comparing the beams with VGBD using the ‘Basic’ matching criteria, all beams were within the specifications (1.5mm at dmax, 1% PDD, and 2% Profiles). When considering the “Fine” matching criteria (1.5mm at dmax, 0.5% PDD, and 2% Profiles), only three of six 6MV beams and two of six high energy (five 18MV & one 15MV) beams passed. Direct comparisons between accelerators using the Clinac IX (installed 2012) as the reference beam datasets resulted in all 6 MV and 18MV beams meeting both the “Basic” and “Fine” criterion with the exception of two accelerators.

Conclusions: Linear accelerators installed up to nine years apart are capable of meeting the manufacturers beam matching criteria for “Basic” matching. Without any adjustments most beams, when evaluated, may meet the “Fine” match criteria. The use of a single dataset (VGBD or designated accelerator reference data) for treatment planning commissioning is acceptable and can provide quality treatment delivery.

Photon Beam Matching Analysis at Multiple Sites Up To Twelve Years Post Installation

Direct comparison: 5 units compared to 1 reference site

Basic Matching: 1.5mm at dmax, 1% PDD, and 2% Profiles

Fine Matching: 1.5mm at dmax, 0.5% PDD, and 2% Profiles

6MV Dmax Analysis Results

	Fld Size	6cm	10cm	20cm	30cm	40cm
	Reference Depth	1.43	1.41	1.33	1.3	1.21
SITE 1	Max Diff	0.04	0.04	-0.07	-0.05	-0.01
SITE 2	Max Diff	-0.08	-0.04	NoData	0.00	-0.10
SITE 3	Max Diff	0.09	0.10	0.09	0.05	NoData
SITE 4	Max Diff	0.09	0.10	0.09	0.05	0.10
SITE 5	Max Diff	0.00	-0.06	-0.03	-0.03	0.01

6 MV Percentage Depth Dose Analysis Results

	Fld Size	6cm	10cm	20cm	30cm
SITE 1	Max Diff	-0.5	-0.5	-0.5	-0.4
SITE 2	Max Diff	-0.7	-0.6	-0.6	-0.5
SITE 3	Max Diff	0.5	0.6	0.3	0.4
SITE 4	Max Diff	0.5	0.4	0.3	0.3
SITE 5	Max Diff	-0.4	-0.3	-0.4	0.3

6 MV Profile (10cm Depth) Analysis Results

	Fld Size	10 cm		30cm		40cm	
		Crossplane	In-plane	Crossplane	In-plane	Crossplane	In-plane
SITE 1	max (+) diff	0.7	0.5	0.5	-0.4	0.7	0.5
SITE 2	max (-) diff	-1.1	-0.3	-0.9	-1.2	-0.8	-0.5
SITE 3	max (-) diff	-0.7	NoData	-0.9	-0.8	-0.7	-0.8
SITE 4	max (-) diff	-0.5	-0.5	0.3	-0.4	0.4	0.4
SITE 5	max (+) diff	1.1	-0.3	0.7	0.7	0.9	1.5

Identical analysis was performed for 18 MV direct comparisons between accelerators. All beams were also subjected to this analysis in comparison to Varian “Golden” beam data (VGBD)