10° CONGRESSO NAZIONALE DELL'ASSOCIAZIONE ITALIANA DI FISICA MEDICA
BARI 12•15 aprile 2018

Quantitative performance evaluation of two linear accelerators through Low function

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TrueBeam Novalis STx

Different Linacs


Trilogy

Purpose: to analyze linacs performance in terms of Low function[1]

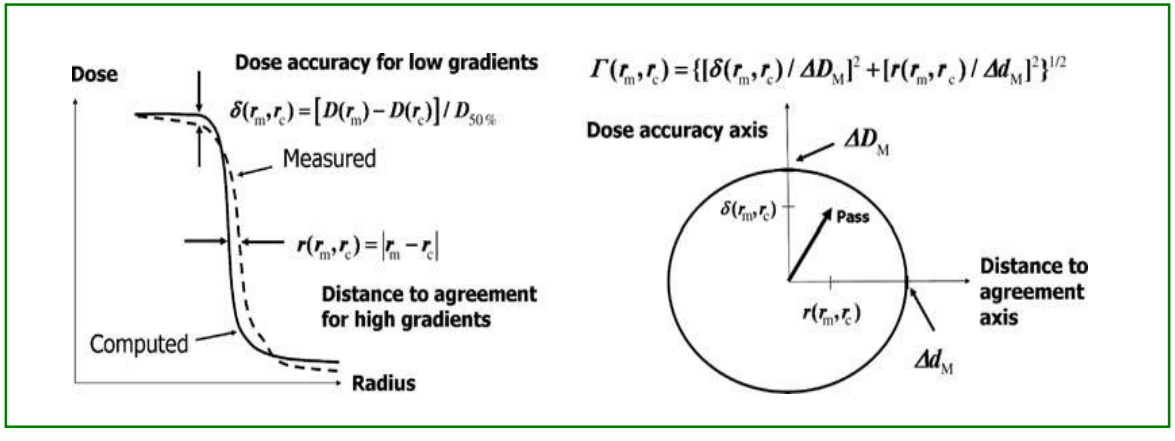
Cylindrical phantom with diodes distributed on two orthogonal planes

Pre-treatment verifications

[1] Low D.A., Harms W.B., Mutic S., Prudy J.A. *A technique for the quantitative evaluation of dose distribution*. Med Phys. 1998;25:656–61

Methods:

- ✓ Homogeneous patient cohort: IMRT and VMAT plans for prostate cancers.
- ✓ Low function parameters:
  - local gamma 3%-3mm
  - at prescription dose
  - diodes in dose range 20-500%
  - threshold 95%
- ✓ For each plan, Gamma Index matrices were calculated for Dose Difference (DD) in the range 0.5-5% and Distance to Agreement (DTA) in the range 0.5-5mm. To evaluate possible differences between the two accelerators, Gamma Index values of treatments were compared, carrying out an arithmetic average on the matrices.



Results for Prostate treatments

PROSTATE TREATMENTS

TRUEBEAM NOVALIS STX

DTA [mm]	Gamma Index Values [%]									
5.0	93.2	95.2	96.9	98.1	99.0	99.5	99.7	99.9	99.9	100.0
4.5	92.2	94.2	96.4	97.7	98.7	99.3	99.7	99.8	99.9	100.0
4.0	91.0	93.3	95.6	97.3	98.3	99.2	99.6	99.8	99.9	99.9
3.5	89.4	92.1	94.8	96.7	98.0	98.9	99.5	99.7	99.9	99.9
3.0	87.1	90.1	93.2	95.6	97.4	98.5	99.2	99.5	99.8	99.9
2.5	83.3	86.6	90.2	93.5	**95.7**	97.5	98.5	99.0	99.3	99.6
2.0	76.0	80.1	84.6	88.9	92.0	94.3	96.1	97.1	97.8	98.3
1.5	63.1	68.3	74.0	78.7	83.0	86.4	89.1	90.9	92.3	93.6
1.0	40.5	47.0	53.9	59.8	65.0	69.4	72.8	75.7	78.2	80.2
0.5	21.2	29.9	37.6	45.0	51.2	56.4	60.5	64.1	67.2	69.7
DD [%]	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0

TRILOGY

DTA [mm]	Gamma Index Values [%]									
5.0	93.8	95.4	96.9	98.2	99.1	99.6	99.8	99.9	100.0	100.0
4.5	92.9	94.5	96.2	97.7	98.8	99.5	99.7	99.8	99.9	100.0
4.0	91.4	93.4	95.6	97.1	98.4	99.2	99.6	99.8	99.9	99.9
3.5	89.5	91.9	94.3	96.2	97.7	98.7	99.3	99.6	99.7	99.8
3.0	87.0	89.3	92.0	94.5	**96.3**	97.5	98.5	99.0	99.2	99.5
2.5	81.7	84.6	87.8	90.7	93.0	94.7	96.0	96.9	97.2	97.7
2.0	68.3	71.8	75.8	79.6	82.5	85.0	86.7	88.3	89.3	90.2
1.5	44.5	49.4	54.3	59.0	62.6	66.0	68.3	70.2	72.1	73.7
1.0	28.9	34.5	40.6	46.1	50.5	54.4	57.2	59.8	62.0	63.8
0.5	17.2	24.3	31.7	38.2	43.6	48.0	51.3	54.2	56.6	58.7
DD [%]	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0

Results: For prostate treatments, a Gamma Index value greater than 95% was obtained up to 2.5%-2.5mm DD-DTA for TrueBeam Novalis STx accelerator and up to 3%-2.5mm DD-DTA for Trilogy accelerator.

Conclusion: The comparison between Gamma Index matrices showed the capability of this verification system to distinguish the different beam delivery of the two accelerators due to different multileaf collimators (minimum leaf size at isocenter of 2.5 mm for TrueBeam Novalis STx and 5 mm for Trilogy).