

## Studi karakteristik berkas foton tanpa filter keluaran linear accelerator 6 MV = Characteristics study of photon of linear accelerator 6 MV without flattening filter

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### Abstrak

Pesawat linear accelerator (LINAC) dengan modalitas tanpa filter perata atau disebut dengan flattening filter free (FFF) telah terpasang di Indonesia. Karakteristik berkas foton pada material homogen dan heterogen LINAC FFF dipelajari pada penelitian ini. Kami menggunakan tiga pembanding, yaitu pengukuran pada phantom dengan menggunakan detektor film radiochromic, simulasi Monte Carlo, dan kalkulasi pada treatment planning system (TPS) dengan algoritma analytical anisotropic algorithm (AAA). Simulasi Monte Carlo dilakukan pada serangkaian perangkat lunak EGSnrc, DOSXYZnrc, dan MATLAB untuk menghasilkan data karakteristik berkas sinar-X FFF. Karakteristik berkas pada fantom homogen menunjukkan bahwa persentase dosis yang diterima permukaan meningkat sebesar 0.7 mm pada LINAC FFF dibandingkan dengan LINAC standar (WFF). Pada lapangan  $10 \times 10$  cm<sup>2</sup>, terdapat penajaman penumbra dengan rasio WFF : FFF adalah 1 : 1.18, selain itu perbedaan dosis pada lapangan kecil antara TPS, simulasi dan pengukuran meningkat tajam seiring dengan penyempitan lapangan radiasi. Karakteristik berkas pada sumbu utama setelah melewati fantom inhomogen berbentuk segitiga dan slab tidak berbeda secara signifikan, tetapi perbedaan terlihat pada sumbu off axis hingga 6% karena pengaruh bidang miring dari material segitiga. Koreksi perturbansi setelah melewati material inhomogen udara dan ekuivalen tulang secara berturut-turut adalah 1.26 dan 0.88.

.....Linear accelerator (LINAC) without flattening filter modalities or called flattening filter free (FFF) has been installed in Indonesia. Photon characteristics of LINAC FFF in homogeneous and heterogeneous materials were evaluated in this study. We used three comparators, i.e. measurements on phantom using radiochromic film detectors, Monte Carlo simulations, and calculations on treatment planning system (TPS) in which anisotropic algorithm algorithm algorithm (AAA) was implemented. Monte Carlo simulations were performed on EGSnrc, DOSXYZnrc, and MATLAB software to generate FFF X-ray characteristic data. Photon beam characteristics in the homogeneous phantom indicate that the maximum relative dose was shifted by 0.7 mm to the surface in LINAC FFF compare to standard LINAC (WFF). On the field size of  $10 \times 10$  cm<sup>2</sup>, there is a penumbra sharpening with a ratio of WFF: FFF is 1: 1.18. Besides, the difference in the small field between TPS, simulation, and measurements were sharpened along with the narrowing of the radiation field. Beam characteristics on the central axis after throughout the triangle shaped and slab inhomogeneity material was not significantly differed. However, the difference in perturbation ratio was seen along the off-axis up to 6% on the triangle shaped inhomogeneity material. Perturbation correction surroundings air and bone equivalent material is 1.26 and 0.88, respectively.